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Economic Assessment of Different Management Approaches of Kakamega Forest in Kenya: Cost-benefit and Local Community Satisfaction Analysis

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Abstract

Economic Assessment of Different Management Approaches of Kakamega Forest in Kenya: Cost-benefit and Local Community Satisfaction Analysis

Kakamega forest, the only tropical rainforest in Kenya is divided into three different parts each under a distinct management approach: a state-led incentive-based approach of the Forest department (FD), a privately-owned incentive-based approach of a local Quakers church mission (QCM) and a state-led protectionist approach of the Kenya Wildlife Service (KWS). Since conservation involves use of resources and distribution of resulting benefits, economic concerns require that resources be allocated in a way that generates maximum net benefits. In addition, understanding the distribution of costs and benefits of conservation among stakeholders is important for informing equity decisions. Cooperation and support of communities living close to forests is essential for ensuring success of conservation efforts. However, more often than not, views of local communities are not systematically elicited, analyzed and incorporated in conservation decisions. The study applied the framework of cost-benefit analysis to analyze the economic efficiency and to compare the distribution of costs and benefits among stakeholders under the three management approaches at the local, national and global levels. The study further applied the concept of consumer satisfaction to analyze local community satisfaction levels with, and their perceptions of the three management approaches and factors influencing them. Further the study investigated the relative importance of different aspects of forest management offered by forest management agencies to the overall satisfaction of local communities. The results indicate that from a global point of view, the three management approaches are economically efficient. However, from the local and national perspective, the opportunity costs of conserving the forest outweigh the benefits. The protectionist approach was ranked highest overall for its performance in forest management by the local communities. Educated households and those located far from market centers were more likely to be dissatisfied with all the three management approaches. The location of the households from the forest margin influences negatively the satisfaction with the protectionist approach whereas land size had a similar effect on the private incentive-based approach of the QCM. In general, the three management approaches are perceived in terms of; involvement in decision-making processes, forest extraction and other mitigation measures and conservation incentives offered in order of importance. Regression results showed that these perceptions were influenced by different sets of demographic and socio-economic factors across the three management approaches. To correct the skewed burden of conservation costs, appropriate compensatory mechanisms are needed. Measures should be taken to enhance more participation of people in conservation processes by all the three management approaches. The overall national development goals of increasing income earning opportunities by integrating communities in modern economy and of promoting education could increase their satisfaction with conservation efforts.

Zusammenfassung

Ökonomische Beurteilung verschiedener Managementansätze des Kakamega Forest in Kenia: Kosten-Nutzen- und Zufriedenheitsanalyse der anliegenden Dorfgemeinschaften

Der Kakamega Forest ist der einzige tropische Regenwald in Kenia. Er kann in drei verschiedene Bereiche unterteilt werden, die mit unterschiedlichen Management ansätzen bewirtschaftet werden: Zum einen den staatlich initiierten, anreizbasierten Ansatz des Forest Departements (FD), zum anderen den privatwirtschaftlichen Ansatz der Quäker (QCM) sowie drittens den staatlich basierten, protektionistischen Ansatz des Kenia Wildlife Service (KWS). Weil Naturschutz sowohl die Nutzung von Ressourcen als auch die Verteilung des daraus resultierenden Nutzens beinhaltet, soll die Ressourcenallokation derart erfolgen, dass der Nettonutzen maximiert wird. Dafür ist es wichtig zu wissen, wie die Kosten und Nutzen des Naturschutzes zwischen den beteiligten Gruppen verteilt sind. Nur dann können Entscheidungen getroffen werden, die Kosten und Nutzen gerecht auf die Stakeholder verteilen. Damit die Bemühungen um den Naturschutz Erfolg versprechen, ist die Zusammenarbeit der lokalen Gemeinschaften mit den verschiedenen Managementbehörden unabdingbar. Dessen ungeachtet werden die Ansichten der lokalen Bevölkerung bei Naturschutzentscheidungen oftmals nur ungenügend ermittelt, analysiert und berücksichtigt. Diese Arbeit verwendet die Kosten-Nutzen-Analyse zur Bewertung der Wirtschaftlichkeit und vergleicht die Verteilung von Kosten und Nutzen zwischen den Stakeholdern in den drei verschiedenen Managementansätzen auf lokaler, nationaler und globaler Ebene. Daneben wird das Konzept der Kundenzufriedenheitsanalyse verwendet, um den Grad der Zufriedenheit mit den drei Managementansätzen, deren Wahrnehmung und die entsprechenden Einflussfaktoren zu eruieren. Die Arbeit untersucht außerdem die relative Wichtigkeit verschiedener Einzelaspekte der unterschiedlichen Managementansätze für die globale Zufriedenheit der lokalen Bevölkerung. Die Ergebnisse zeigen, dass alle drei Managementansätze aus globaler Sicht ökonomisch effizient sind. Allerdings übersteigen die Opportunitätskosten der Erhaltung des Waldes aus der lokalen und nationalen Perspektive den daraus resultierenden Nutzen. Die lokalen Gemeinschaften bewerten den protektionistischen Ansatz durchweg als am leistungsfähigsten. Haushalte mit einem hohen Bildungsniveau und solche, die weit entfernt von Absatzmärkten leben sind mit jedem der drei Managementansätze eher unzufrieden. Die Entfernung der Haushalte vom Waldrand beeinflusst die Zufriedenheit mit dem protektionistischen Ansatz negativ. Einen ähnlichen Effekt hat die Größe des Landebesitzes auf die Zufriedenheit mit dem anreizbasierten Ansatz der Quäker. Es wird ein angemessener Mechanismus benötigt, der die derzeit bei den Gemeinden liegenden Opportunitätskosten kompensiert. Es sollten Maßnahmen ergriffen werden, die eine größere Beteiligung der Bevölkerung bei Naturschutzbelangen in allen drei Ansätzen sicherstellen. Die Ausweitung der Möglichkeiten von Einkommenssteigerung sowie die Förderung von Bildung können die Zufriedenheit der Bevölkerung mit den Naturschutzbemühungen ebenfalls vergrößern.

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Acronyms and Abbreviations

BIOTA-Biodiversity Monitoring Transect Analysis

CBA-Cost-Benefit Analysis

CBD-Convention on Biodiversity

CBO-Community-based Organization

DFO-District Forest Officer

FA-Factor Analysis

FAO-Food and Agriculture Organization

FD-Forest Department

GIS-Geographical Information System

GoK-Government of Kenya

ha-Hectare

IRR-Internal Rate of Return

IUCN-International Union of Conservation of Nature

KFMP-Kenya Forestry Master Plan

KFS-Kenya Forestry Service

KIFCON-Kenya Indigenous Forest Conservation

km-Kilometer

Ksh-Kenya Shillings

KWS-Kenya Wildlife Service

NGO-Non-Governmental Organizations

NPV-Net Present Value

OLS-Ordinary Least Squares Regression

QCM-Quakers Church Mission

US $- American dollar

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1.0 INTRODUCTION

1.1 General Background to Forest Biodiversity in Kenya

The term 'biodiversity' or 'biological diversity' is a composite term which assumes an array of meanings; some static such as "variety of life forms" on earth (Takacs, 1996 p. 2) and others dynamic, incorporating processes and interactions between components that are part of biodiversity. The convention on biodiversity (CBD, 2000 p. 2) defines biodiversity as the variety of life forms on earth and the patterns it forms including all living organisms and the processes and interactions that sustain them. This definition includes all living organisms and the processes and interactions that sustain them. Biodiversity can be explained in terms of wide variety of plants, animals and micro-organisms found on earth, genetic differences between species, existing variety of ecosystems such as deserts, forests, wetlands, mountains, lakes, rivers and agricultural land. Overall, biodiversity can be viewed as part of the complex web of life in which, the life of human beings is part of and wholly depends upon.

Wass (1995 p. 1) defines forests as continuous stands of trees at least 10 meters tall, with interlocking crowns. Forest biodiversity plays crucial roles in the lives of communities and nations; apart from being reservoirs of other forms of biodiversity, forests play an important role as source of timber as well as an array of non-timber products. Plants and animals provide food, fuel wood, medicinal plants, fodder, and industrial raw materials such as fibers, resins and dyes. In recent times forest biodiversity has also been providing a very important service in the new and growing leisure industry, which involves the 'non' consumptive use of biological diversity for example eco-tourism. Forest biodiversity also provides very important ecosystem services that are generally considered to be 'free'. Such essential services include nutrient cycling, soil formation, watershed protection, waste disposal, pollination, oxygen production and carbon sequestration. It also has a 'hidden' value locked up in the genetic stock whose potential value is not yet known. Forests also play essential role as repositories of aesthetic, ethical, cultural and religious values of communities that live adjacent to them.

In Kenya, the gazetted forests occupy about 1.24 million hectares representing a paltry 2.8% of the total land cover out of which 88% are indigenous while 12% are plantation forests (Wass, 1995). Outside the gazetted forests, there are other large tracks of forests in trustlands (national parks, national reserves) and in privately owned land covering about 0.5 million hectares. This sharply contrasts the world's average forest cover of approximately 30% of the total land area (FAO, 2006). Although forests in Kenya account for only a small percent of the land cover, they contain a large proportion of biodiversity. Approximately 40% of the large mammals, 30% of the bird species, 35% of butterfly species and an unknown but high percentage of woody plants are found in forest habitats (KFMP, 1994).

Forests in Kenya can be classified into four types according to climatic conditions of the regions they are found; costal forests, dry zone forests, montane forests and the western rain forests. Table 1-1 shows the distribution of these forests by size across the four different regions. Kakamega Forest, the research area for this study, is located in the western rain forest region. As shown in Table 1-1 the montane forests form the bulk of the Kenya forest cover followed by dry zone forest, costal forest and western rain forests in that order.

Table 1-1: Distribution of forests in Kenya across climatic regions

Region	**Type of Forests in hectares (Ha)**	
	Indigenous	**Plantations**
Costal forests	82,500	3,200
Dry zone forests	211,000	8,200
Montane forests	748,500	102,800
Western rain forests	49,000	18,600

Source: Wass, 1995

These forests fall under different management regimes with different legal status. Majority of the closed canopy forests are designated as forest reserves under the Forestry Act (Chapter 385 of the laws of Kenya) and are managed by the Forest Department (FD) which falls under the Ministry of Environment and Natural resources[1]. By definition forest

[1] In February 2007, a new forest law came into effect. Under the new law FD was transformed into a semi-autonomous state agency called Kenya Forestry Service (KFS).

reserves refer to land areas that have been surveyed, demarcated and gazetted either from trust land or unalienated government land. Some closed canopy forests are designated as national parks or national reserves and are managed by a semi-autonomous government agency known as the Kenya Wildlife Service (KWS) which operates under the Ministry of Wildlife and Tourism. An estimated 100,000 ha of forest in Kenya are under Trust land and are managed by the Ministry of Local Government through local county councils, which hold the forest land in trust for the local communities. Unknown areas of indigenous forest are managed under private ownership. Some forests whose biodiversity is threatened for example, Kakamega forest, are managed jointly by FD and KWS based on a memorandum of understanding drawn between them. The memorandum spells out specific areas of cooperation between the two agencies and the specific responsibilities of each. In essence, the two agencies try to create synergies in forest management based on each agency's specific areas of competence. For example, the memoranda might specify that whichever of the agency has more capacity to patrol should offer help to the one with weaker capacity.

Despite the relatively small forest cover, there is a high dependence on forests for provision of wood and non-wood products in Kenya. A study carried out under the Kenya Indigenous Forests Conservation Project (KIFCON, 1994) using the figures of the 1989 population census estimated that there were about 3 million people (about a tenth of the total population) living within a 5 km radius of forest margins and depending on the forest for various needs. As much as 90% of energy requirements by rural households in Kenya are met mainly by using fuel wood most of which comes from forests (Mahiri and Howorth, 2001). In spite of the important role that forest play in the livelihood of the forest adjacent people and the nation as a whole, loss of forest through deforestation and degradation has continued to take place at an alarmingly high rate. According to FAO (2006) forest cover estimates, Kenya lost 62,000 ha of its forest cover between year 2000 and 2005. The current trend of forest loss can be explained by excessive pressure on agricultural land that lead to encroachment of forests, policy framework that makes forest products from public forests cheaper than those from private forests, exclusion of the local peoples needs in the conservation process, a generally weak enforcement capacity of the management

authorities, and a legal framework that makes it easy for legal excision to be made by government without consultation of other stakeholders.

In an attempt to address these problems, the government of Kenya recently enacted a new law; Forest Act 2005. The new law which came into effect in February 2007 envisages more participation of forest adjacent communities in forest management in the form of joint-management with the government through community forest associations. To alter the past trends of unregulated legal forest excisions by the central government, the new law prohibits the government minister in charge of forests from carrying out excision of forest land without thorough consultation with other stakeholders. The new law transforms the Forest department into a semi-autonomous governance authority which is able to raise revenue, draw up its own budget and have more policing power. The new law has potential to address some of the problems affecting the Kenyan forestry sector but its success or failure can only be assessed after several years of its implementation. The next section gives a detailed description of Kakamega forest with the aim of providing background necessary to set out research problem that this study addresses.

1.2 Description of the Study Area

1.2.1 Biophysical Profile

Among the few remaining indigenous forests in Kenya, Kakamega Forest is unique in several ways. It is the only remaining patch of Kenya's Guineo-Congolean rain forest, which spanned from west and central Africa, to Eastern Africa with its easternmost edge in western Kenya. The forest is also famous for its diversity of unique and numerous flora and fauna (Kokwaro, 1988). The Forest is an important bird conservation area in the country hosting about 330 bird species a number of which are endemic, several species of monkeys (the red-tailed, blue, de Brazza's and black-and-white colobus), antelopes (Duiker and Bushbuck), snakes (forest cobra, Gaboon viper, Rhinoceros-horned viper), about 400 species of butterflies and several moth species and over 390 species of vascular plants besides other plant species (Althof, 2005). The rich biodiversity makes Kakamega Forest an important global conservation area; in 1995, IUCN ranked Kakamega forest as the third

highest priority for conservation among Kenyan forests. However, the Forest has a low density of small and large mammals mainly due to past and current human impacts especially through hunting and natural epidemics such as rinderpest which is suspected to have decimated most large mammals from the forest in the 1920's (Mitchell, 2004).

Kakamega Forest is located in Western province in Kenya, and lies between latitudes $00^0$08'30.5'' N and $00^0$22'12.5''N and longitudes $34^0$46'08.0''E and $34^0$57'26.5''E at an altitude between 1500m and 1700m. The forest covers an area of about 240 Km^2 out of which about 10% is plantation forest while the rest is under natural forest. As shown in Figure 1-1, Kakamega forest is not a single continuous forest block; it consists of one main forest block that is surrounded by three satellite fragments with distinct names; to the north of the forest there is the Malava and Kisere fragment while to the south is the Kaimosi fragment[2]. In this study the term 'Kakamega Forest' shall be applied as a composite term in reference to both the main forest and its three satellite fragments. To the East, Kakamega forest borders the North Nandi Forest which is found on an escarpment which stretches in north-south orientation. The Nandi escarpment is located about 200 to 300m higher (see Figure 1-2).

Examination of vegetation cover in Kakamega forest (Figure 1-3) reveal that the forest has several classes of land cover ranging from primary forest (unaffected by deforestation previously), secondary forest (recovering from previous deforestation), plantation, bushland, grassland to agricultural land. There are several grassy glades inside the Forest whose origin is rather uncertain but are speculated to have arisen as a result of deforestation or human activities e.g. fires or grazing and movement of large animals (Kambona, 2005). Figure 1-4 show an example of a grassy glade found inside Kakamega forest. Most of the Forest lies on undulating terrain, with two steep hills; Buyangu and Lirhanda which rise several hundred meters above the forest.

[2] Different parts of the forest are managed by three different agencies i.e. FD=Forest Department, KWS=Kenya Wildlife Service and QCM=Quakers Church Mission as shown in Figure 1-1.

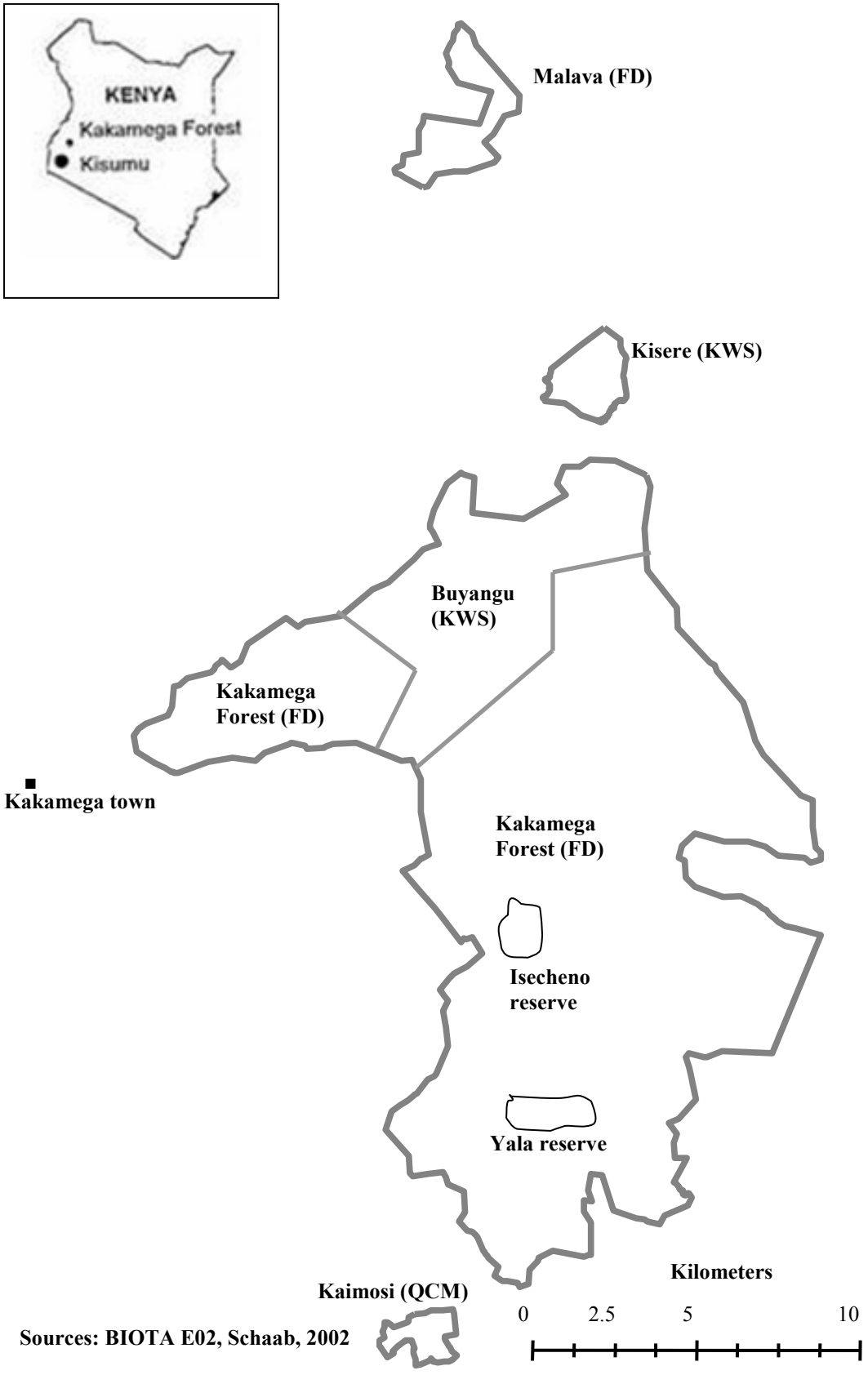


Figure 1-1: Map of Kakamega forest and its fragments

Figure 1-2: Kakamega forest from space

Source: Google Earth

There are several small rivers and streams that cross the forest with two main river systems, the Isiukhu river in the north and Yala river in the south. The soils are generally low fertile Acrisols, which are heavily leached, medium to heavy texture clay-loams and clays, usually acidic with pH below 5.5 (KIFCON, 1992). Organic materials of the forest cover falling to the ground are reincorporated into the soil hence maintaining its current level of fertility. When this cycling is disrupted through removal of live or dead fuel wood and logging leads to a decline in soil fertility.

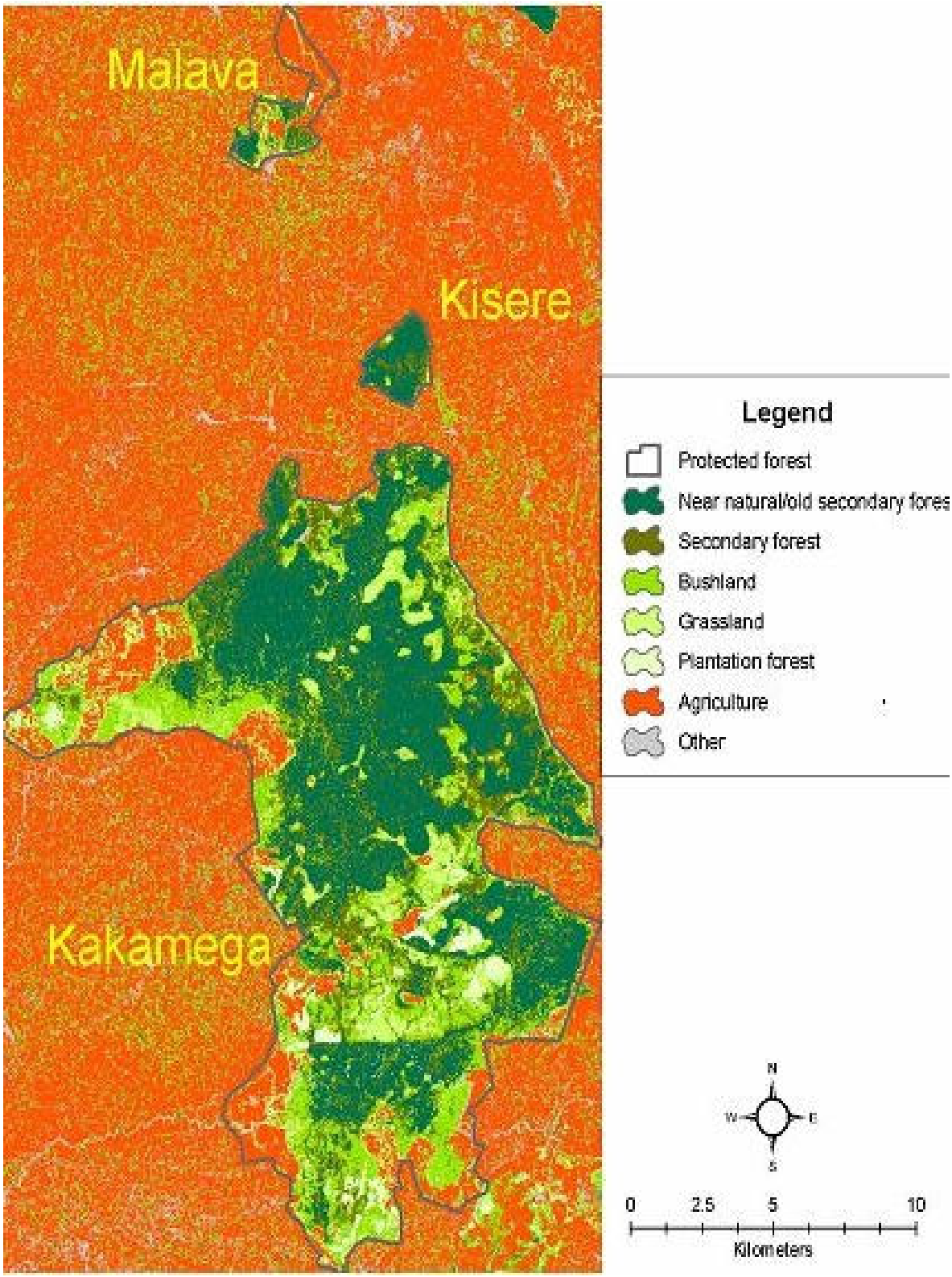


Figure 1-3: Vegetation cover in Kakamega forest

Source: BIOTA E02, 2002

Climate of the area around Kakamega forest is closely related to and affected by Lake Victoria located about 43 km away to the southwest. The Lake has its own circulation system which influences precipitation in the region. The area receives sufficiently high rainfall that is well distributed throughout the year with two rainy seasons. The long rains start in March and end in June; and the short rains that begin in July and end in September with a peak in August. The total annual rainfall averages between 1500- 2000mm/annum. As noted by Althof (2005), Kakamega forest itself influences precipitation through its huge biomass of forest vegetation which in itself is a big water shed system. During the day the heat leads to high rates of transpiration which later develops into clouds and release moisture as rain in the afternoon.

Figure 1-4: Grassy glade inside Kakamega forest

Source: Author's Photography, 2005

Contrary to expectation, to a limited extent high disturbance and fragmentation of the forest might leads to heavy rainfall mixed with hail because without vegetation or with sparse vegetation cover the area heats up more and most hot air mass are transported higher up into the atmosphere coming into contact with cold air leading to heavy hail storm with strong rain (Althof, 2005). The area has high temperatures all the year round with slight

variations in mean maximum and minimum ranges of 28^0c to 32^0 c and 11^0 c to 13^0 c respectively. The coldest month is July while the hottest daily temperatures are recorded in January and February. The combination of soil and climate places about 60% of the forest in the tea/coffee agro-ecological zone with agricultural potential under mixed cropping by smallholder farmers (KIFCON, 1992). Favorable rainfall and temperature makes the area conducive for growing the main food crops like maize, beans, tea, sugarcane and also horticultural crops.

1.2.2 Socio-economic Profile

According to the 1999 population census, the locations within 5 km radius to the forest had a total population of about 376,169 people (GoK, 2000). The projected population growth between 1999-2010 indicate that the population will continue to grow at an average rate of about 3% which is slightly above the average national growth rate of 2.6 % (GoK, 2000). The area has an average population density of 461 people per km², making it one of the Africa's most densely populated rural areas (GoK 2001). It is also estimated that the number of people in the district who earn less than a dollar per day account for over 57% of the population (GoK 2001). Over 90% of the people living in the rural areas of Kakamega depend on agriculture either directly or indirectly. The people are dependent on growing crops such as tea, sugar cane, maize, beans, sweet potatoes as well as keeping cattle on increasingly small pieces of land especially due to continuing sub-division through inheritance. Due to small land sizes people tend to intensively use their land for crop cultivation without providing for fallow period to allow the soil to regain its fertility. This in combination with low use of other inputs such as inorganic fertilizers has led to a decline in productivity and falling farm incomes (Ogutu, 1997).

The area to the north of the forest is well suited for growing sugar cane while the area to the south of the forest is mainly tea growing area. Sugar cane and tea are the main cash crops grown in the area and two main processing companies are located in the area; West Kenya Sugar Company purchases sugar cane from the local people and processes sugar for sale both locally and in other parts of the country. To the south of the forest near Kaimosi there is a tea factory known as Mudete Tea Factory which serves as the main buyer and

processor of tea in the area. Other crops grown in both areas include maize, beans, cowpeas and bananas. Farmers in the area keep livestock mainly cattle and poultry but there are limited numbers of sheep, goat and pigs. Due to lack of enough grazing land cattle is reared around homesteads using zero-grazing or grazed in the forest. Given the prevailing levels of poverty and economic growth projections, the current patterns of dependence on the forest are unlikely to change in the foreseeable future.

The forest is likely to remain under constant threat of degradation since local communities continue to depend on it for basic necessities such as fuel-wood, charcoal, building poles, traditional medicinal plants and grazing land. Even in the well protected KWS-managed part of the forest there are incidences of illegal logging, charcoal burning and occasional hunting of small animals. The government has been encouraging people to grow woodlots on their land so that they can become self-reliant in firewood, timber and building poles but the main challenge is competition with food crops for the increasingly small plots of land.

1.3 Historical Overview of Management and Utilization of Kakamega Forest

Early records indicate that the first boundary around the Forest was physically established around 1908-1910. This boundary was modified in 1912-13 and much later in 1929-1932. The annual government report of 1918 indicates that there was opposition from local communities to any sort of control of the forest by government (Mitchell, 2004). After the establishment of the first boundary, Kakamega Forest was still managed indirectly by the local people through their village elders who were under the authority of the local native council. In 1931, FD took over the management of the forest from the local people against a very strong objection of the local people, who wished to retain control. Despite the local people's opposition, Kakamega Forest was gazetted as a trust land forest on 13th February 1933 which meant that although the forest would remain the property of the local people, the central government would manage it on their behalf. The argument for this take over was for the improvement and maximization of its economic benefits. The establishment of the Mombasa-Kisumu railway line in the early 1900's and the associated demand for fuel wood needed to run the steam trains led to establishment of eucalyptus plantations on the forest land to meet the demand for fuel wood. In 1931 gold was discovered in the forest

and this led to an influx of several European prospectors into the forest with several thousand employees (Mitchell, 2004). Concessions for prospecting were established in the forest and led to opening of the Forest to official and commercial scale logging. Local residents were evicted from the forest and from then on, the forest was managed for colonial timber enterprise with establishment of sawmills in the forest (Glenday, 2006). Widespread commercial logging led to clear felling of some parts of the forest which were converted to timber plantations of indigenous hardwoods (KIFCON, 1994). The FD initiated the non-resident cultivation in the 1940's in which local farmers were allowed to plant food crops on cleared plots in the forest while tending the tree seedlings. However, this practice was stopped by the government in 2003 because of the associated problems of encroachment and abuse by corrupt forest officials. A few customary rights of the people to the forest have been reinstated by special rules for example in 1959 and again in 1964, the rights of the local people to use the forest for grazing, cultivation and collection of firewood (Mitchell, 2004).

In 1964 the forest was declared a central government forest which technically meant that it now belong to the state and not just to the local communities. In 1984 a presidential directive banned the conversion of indigenous forest to plantation and another in 1988 banned the cutting of indigenous forest trees. In 1985 two areas were officially excised from the forest to create the Kakamega National Reserve, encompassing Kisere fragment and the northwestern part of the main forest block also called Buyangu (see Figure 1). Since then, the two fragments covering approximately 44 km^2 have been managed under the protectionist approach of KWS on behalf of the central government. This part of the forest is conserved almost in its pristine form as a national reserve and is used for tourist visits, camping and nature trails. The local communities are not allowed to extract any timber or non-timber products from the KWS managed part. According to Mitchell (2004), Kisere Forest was already separated from the main block as early as 1913/16. This fragment has always been protected from large scale exploitation of the major sawmills mainly due to its inaccessibility from Kakamega town. Kisere is cut off from Kakamega town by Isiukhu and Nandamanywa Rivers hence saw millers had difficulty logging from this part of the Forest. The southern part of the main forest block and Malava fragment

covering an area of about 200 km^2 are managed by the FD under an incentive based approach. However, FD has set apart two small nature reserves i.e. Isecheno and Yala and people are not allowed to extract from these parts of the forest (see figure 1-1). As far as records extend, Malava fragment has always been separated from the main forest block. The fragment is currently divided into eastern and western parts by the Kakamega-Eldoret road. The fragment was heavily logged in the early 1940's and the eastern part of the forest was re-planted in the 1950's (Mitchell, 2004). In the FD managed part, regulated forest extraction activities such as grazing, collection of dead timber for fuel wood, mushrooms, fruits and medicinal plants are allowed for the local communities. In 1991 a memorandum of understanding was drawn between the FD and KWS, to work closely together in the management of the Forest. However, many of the rules are not strictly enforced by the FD while, in contrast, KWS strictly prohibit local use of the forest in the national reserve. Since early 1900's the southern fragment also known as Kaimosi covering about 130 Ha has been under incentive-based quasi-private management of a Quakers Church Mission (QCM) which allows the local communities limited and regulated extraction of forest products.

Over the years the forest has been subjected to disturbances of various kinds. In the pre-colonial days, the local people were actively converting the forest into farmland but this was checked by natural calamities such as diseases and wars (Mitchell, 2004). In the colonial days, various massive disturbances occurred; gold mining and logging, timber extraction by saw millers and fuel wood collection and charcoal burning by the local people. Overall, the size of the forest has been shrinking rapidly due to high human population growth and increased resource extraction in the last century. A study by Lung and Schaab (2004) indicated that approximately 20% of the forest cover was lost in the last three decades. A recent study by Bleher *et al*, (2006) found historical evidence of high level human impact throughout the forest with illegal logging being most widespread. However, the level of logging appears to reflect management history and effectiveness; since 1985 the KWS managed part has had significantly lower cases of illegal logging. There is an apparent gradient of disturbance in Kakamega Forest with the KWS-managed national reserve being the least disturbed and the QCM fragment being the most disturbed (Lung

and Schaab 2004; Mitchell, 2004; Althof, 2005). The next sub-sections (1.3.1 and 1.3.2) provide more details on the actual operations of the three management approaches i.e. protectionist-oriented approach of KWS and the incentive-based approaches of FD and QCM.

1.3.1 Protectionist-oriented Conservation in Kakamega Forest

Kenya Wildlife Service (KWS) has been managing its part of the Forest (about 44 Km^2) under a strict protectionist approach since taking over in 1985. KWS operates as a semi-autonomous institution under the Ministry of Wildlife and Tourism with authority to raise funds, hire staff and carry out its affairs independent of the parent ministry. It was established under the Wildlife Conservation and Management Act (Chapter 376) of the laws of Kenya as an authority to manage and coordinate conservation of wildlife in the country. KWS has it headquarters in the country's capital city, Nairobi with field offices in all regions in the country. The Kakamega office of KWS is headed by a warden, two deputies; 5 support staff and about 25 armed guards. KWS provides housing for most of its staff inside the forest at Buyangu; the warden and his two deputies are housed in permanent houses while the guards are housed in grass-thatched mud-walled houses. KWS has two offices; one located in the Forest at Buyangu and another located in Kakamega town; the two are linked by radio communication. During the time of the study, KWS had two operational motor vehicles and one tractor. The gate into the reserve is manned at all times by two guards who also collect gate fees and issue receipts to tourists entering the forest. Several staff take care of the camping site and the traditional huts that are used for tourist accommodation. Daily patrols are carried out by armed forest guards either early in the morning, late in the evening or as need arises. The main challenge is lack of enough patrol vehicles to cover the whole forest. Therefore, cases of illegal extraction continue though not as rampant as in the rest of the forest.

In brief the KWS office in Kakamega is mandated to do the following among other functions as stipulated in the Wildlife Conservation and Management Act of the laws of Kenya (1989);

a) Carry out the day-to-day management of the national reserve

b) Draw out management plans for the reserve
c) Sustainably manage wildlife to meet conservation goals
d) Generate income from the reserve through non-consumptive uses such as tourism
e) Provide the local communities and local authorities with education on the importance of conservation
f) Work closely with local communities and local authorities on the best methods to conserve wildlife
g) Protect farming communities from wildlife damage and compensate them when damage occurs

Under the protectionist policy of KWS, the local people are strictly excluded from extracting any product from the forest and any unauthorized entry into the forest is forbidden. Failure to comply with these requirements often leads to arrest, legal prosecution and punishment. This policy is meant to ensure that the forest biodiversity is conserved in its pristine form. In addition KWS offers tourist attractions such as bird watching, camping site, picnic site, nature trail walks and such other activities. In recent years the income from gate entry and camping fees from tourists have been quite substantial for example in 2005 gross income from gate fee collection from domestic and international tourist tourism amounted to Kshs 3,374,460 (US $ 45, 600). However, it is important to note that all these income that arise from forest accrue to the state with little benefits if any at all going to the local communities. KWS is also supposed to carry our programs to educate people on the importance of conserving wildlife and also closely work with them on the best ways to do it. The implementation of these programs however is limited by shortage of funds. Crop damage by wild animals still remains a thorny issue in the study area; however KWS lacks the capacity to either prevent it or compensate for the damage whenever it occurs. However, damage is mainly limited to farms that are immediately adjacent to the forest because wild animals causing damage do not move far distance from the forest.

To a large extent, KWS carries out its operations with limited involvement of the local communities but operations of a CBO known as KEEP (Kakamega Environmental

Education Program) is a rare example of the limited community involvement in conservation. Acting jointly with FD, KWS has allowed KEEP to carry out a number of income generating and educational programs within its grounds. The CBO has two branches one operating in KWS managed part at Buyangu and another in the FD part at Isecheno and has approximately 40 staff engaged in its day-to-day activities. KEEP is involved in several income generating activities as well as environmental education initiatives in local schools and other public fora. It also runs a tree nursery and tour guide services to tourists visiting the forest. KEEP not only offers employment opportunity for the people it employs but also increases conservation awareness of the locals and provides them with opportunity to earn income through promotion of butterfly farming and providing a marketing channel for the butterfly pupae. KEEP if well managed offers some potential to increase positive attitudes towards conservation not only through direct economic and educational benefits but also through the opportunity to organize and form a formidable group that can channel views of the local people to the forest management authorities. However, KEEP represented a rather limited level of community participation in forest management since its operation within the forest grounds solely relies on the goodwill of the state agencies.

The performance of KWS with regard to preservation of biodiversity as compared to the incentive-based approaches evokes an important question; can the dual goal of biodiversity conservation and controlled forest extraction be achieved? The answer to the question is not a necessarily straight yes or no but it largely depends on the local conditions. Some recent research suggest that in many cases protectionist approach can be effective in conserving biodiversity by stopping land clearing, mitigating logging, hunting and grazing but this effectiveness is closely correlated to basic management activities such as enforcement, boundary demarcation and direct compensation to the local communities (Bruner *et al,* 2001). The next section provides an insight on the operations of the incentive based management approaches of FD and QCM.

1.3.2 Incentive-based Conservation in Kakamega Forest

Incentive-based conservation approach is applied to varying degrees by both FD and QCM. FD operates as a department under the Ministry of Environment and Natural Resources of the Kenyan government. As noted in the introduction, in the course of this study there was an ongoing process to transform FD into a semi-autonomous authority under a new name of Kenya Forestry Service (KFS) in accordance with a newly enacted law. Unlike KWS which has a more robust mandate to manage the reserve, FD has to rely on instructions of the parent ministry for guidance. For example, the extraction rules are not fixed but change from time to time depending on the instruction from the parent ministry. In general however, the overall mandate of FD in Kakamega is to oversee day-to-day management of the reserve, ensure that the reserve is managed so as to sustainably conserve biodiversity, educate the local communities on the importance of forest conservation, provide tree seedlings to the local communities at subsidized prices and to ensure that offenders are apprehended and prosecuted.

The Kakamega District Forest Officer (DFO) is based at Lurambi on the outskirts of Kakamega town and is in charge of the management of Kakamega forest and Bunyala forests. The DFO reports to the provincial forest officer, western province, who is in turn responsible to the Chief conservator of forests based in Nairobi. A resident forest officer based at Isecheno forest station located about 17 Km from Kakamega town in the southern part of the forest is directly in charge of the forest and he/she reports to the DFO. The Isecheno station has 12 permanent staff houses, offices, a guest house and a tree nursery but there is no fixed telephone linking it to the DFO's office. FD had about 35 forest guards and several technical staff. During the time the field research was being undertaken, the FD had three operational vehicles. Informal interviews with the DFO indicated that illegal activities were going on at a high rate and enforcement was limited by inadequate budgets, manpower and patrol vehicles.

FD allows the local communities some limited and regulated use of the forest through grazing, collection of dead wood for fuel, medicinal plants and mushrooms but they have to

pay access fee for grazing, fodder and thatch grass. In contrast to the KWS managed part, entry to the FD part is not tightly restricted but there is a barrier at the entrance which is manned during the day. Local people who enter into the forest to collect firewood are required not cut trees but collect only dead wood. However, due to less rigorous enforcement and corrupt practices by guards, cases of illegal extraction are more rampant in the FD managed part compared to KWS managed part. Main illegal activities include logging, charcoal burning, debarking of trees for medicinal purposes and hunting of small animals (Mogaka *et al*, 2001). In the period before 2003, FD allowed the non-resident forest cultivation locally known as the '*shamba'* system in parts of the forest under plantation. Under this system, the local people were allowed to grow crops on the forest land while tending the young tree seedling until they formed canopy. The cycle would repeat once the trees were logged and new tree seedlings were planted. In many places in the country this program was highly abused by corrupt forest officers who allowed local communities to encroach on the forest. This led to the scrapping of the system by the government in 2003. In addition, before 2003, FD used to have a program of selling old mature trees from the forest for selective logging by saw millers. This program was also stopped due to widespread abuse and corruption. During the time of study, the only legal extraction that was allowed was non-timber forest products by local communities.

Community participation in actual forest management is rather limited under FD managed but occasional public meetings are organized to educate people on the importance of conserving the forest and also get their views on how best to achieve it. However, the local communities remain largely excluded from the actual decision-making process in the management of the forest. This was partly due to the previous forestry law which did not explicitly account for the participation of the local people in the management of the forest. This is set to change with the enactment of the new law because it allows the local people to organize themselves into forest associations and to jointly manage the forest with the newly created KFS. But as noted earlier KEEP is allowed to operate within the forest grounds with their main office based at the Isecheno forest station. At Isecheno KEEP provides tour guiding services for tourists at a fee. During the time of the study, KEEP was in the process of building traditional huts for lodging purposes in the forest. Problems of

crop damage by wild animals are common but FD like KWS lacks the capacity to prevent it or compensate for it whenever it occurs.

Recent ecological and GIS-based studies have shown that the FD managed part is more disturbed than KWS part (Lung and Schaab, 2006). A study on forest regeneration by Bleher *et al*, (2006) concluded that the differences in the status of biodiversity were a reflection of management effectiveness rather than ecological differences. The study noted that in the period before 1985 the whole forest was equally disturbed particularly through logging as evidenced by presence of tree stumps throughout the forest. But the KWS managed part has shown steady recovery compared to others. This observation again begs for the same question posed in Sub-section 1.3.1 on whether allowing forest extraction compromises conservation goals.

The QCM management is headed by a Secretary General (SG) who is also responsible for the day-to-day management of the affairs of the mission. Management of the forest falls directly under his office and the forest is managed as a private property of the church with the SG being the official in-charge. The SG has delegated the supervisory functions of the forest to a caretaker who also acts as a patrolman because the church does not have regular armed guards. Local people extract different types of products from the forest such as fuel wood and thatch grass as well as graze inside the forest. The SG office occasionally sells out some trees in the forest for logging to individuals from the local community. Community participation in its management is rather limited but occasionally the church organizes public meetings to educate people on the importance of conservation. The church also organizes tree-planting days in collaboration with local schools and the community. The church also has a fully-fledged rural outreach program that focus on development and dissemination of technologies such as energy-saving cooking stoves, promotion of agro-forestry through provision of tree seedlings, promotion of hybrid seeds and such others.

1.4 Research Problem

Management approaches of public forests, whether they are protectionist oriented or incentive-based are important in determining outcomes of conservation and sustainable use (Kant, 2000). From an organizational point of view, a management approach may take the form of centralized management; where state agencies assume the lead role, decentralized management; where local communities are involved at varying levels, private management; where private entities own and manage the resource, and co-management; where state, local communities and other actors share management functions, rights and responsibilities (Mburu and Birner, 2007; Meinzen-Dick *et al*, 2002). These management approaches not only define and assign property rights to various stakeholders differently, but they also guide use of the resource and consequently determine the conservation outcomes (Meinzen-Dick and Di Gregorio 2004; Oakerson, 1992). Among other outcomes, forest management approaches ought to meet the needs expected from the resource by the society such as economic efficiency, equitable benefit sharing, appropriate conflict resolution and participatory decision-making.

Public forests are managed as economic resources to generate timber and/or non-timber products as well as ecosystem services such as water catchment, carbon sequestration and soil conservation as well as being reservoirs of biodiversity. Apart from land on which the forests stand, other resources such as capital, cash and labour ought to be allocated in a way that maximizes net benefits from a given outlay of resources (Kao and Yang, 1991; Kao *et al*, 1993). As noted by Mburu and Birner (2002), efficiency in nature conservation can be viewed as involving two decision problems; first, identifying the level of nature conservation that is efficient (allocative efficiency) and second, identifying the organizational/management structures that makes it possible to achieve the conservation goals at the lowest cost. Whatever form of management approach is chosen, there are associated costs and benefits that arise and are borne by different stakeholders involved in conservation. From the perspective of economic efficiency a management approach would be considered efficient if it generates a net positive contribution to the society regardless of the distribution of the benefits among the different stakeholders. Economic efficiency could

be looked at as a measure of the net contribution of an activity or project to overall social welfare. Thus, economic efficiency is designed to answer the question of whether the redistribution of resources implied by a project or an activity results in improvement of societal welfare. Therefore, given two organizations that generate the same level of benefits, the one that does it at a lower cost can be said to be more efficient. Consequently evaluating efficiency of forest management structures is important for guiding conservation policies (Kao, 1998; Kao and Yang, 1991). However, as noted by Joro and Viitala (1999) there are limited number of studies that have attempted to measure economic efficiency in forest management. In particular there is limited literature on financial and economic analysis in comparing the performance of different management approaches of forest conservation especially in the tropics. This study therefore intends to shed light on how different forms of forest management influence the resulting economic efficiency in a tropical setting. Apart from economic efficiency, understanding distribution of costs and benefits among different stakeholders in conservation is important for guiding equity considerations (Ferraro, 2002). This is particularly important in the case of tropical forest where many forest adjacent communities bear the opportunity cost of conservation i.e. the forgone opportunity to use the forest land for farming activities. Distribution of costs and benefits of conservation has an influence on incentives for or against conservation among different stakeholders.

Apart from economic efficiency concerns, the persistence of degradation of natural resources and failure of simple technical or economic prescription has led researchers to consider the more complex aspects of natural resource management. In this respect, research has pointed out the centrality of the local communities in the process of natural resource management (Wiggins *et al*, 2004; Trakolis, 2001). It has been widely argued that success of forest conservation efforts will depend on the support of the local communities that live adjacent at the local level (Wiggins *et al,* 2004; Ferraro, 2002; Trakolis, 2001; Rasmussen and Meinzen-Dick, 1995). Well-meaning measures of environmental conservation may negatively impact on the livelihoods of the local inhabitants and this may reduce the effectiveness of the intended policies. As noted by Bruce *et al* (2002), public acceptance is of utmost importance to every management decision that public agencies

make concerning natural resources. In many developing countries, the local people had been managing these forests before they were taken over by local or national governments and in many cases they view themselves as the *de facto* owners of these forests. As noted earlier, for the particular case of Kakamega Forest, for a long time, the forest was owned and managed by the local people before being taken over by the central government to manage it on their behalf. Therefore, the local people can be looked at as the "clients" on whose behalf the resource is being managed. Any external management intervention can be correctly evaluated from the perspective of the local people. One way of evaluating the forest management approaches from the local communities' perspective is through generating their satisfaction levels with the way the forest is managed (see Andersson, 2004). Understanding the overall level of satisfaction of local communities with forest management and the relative importance of different aspects of forest management in their overall satisfaction can provide an understanding of how well the management is meeting their expectations. Although rare the concept of consumer satisfaction as applied in service oriented sectors such as education, health and marketing can be adapted and applied in forest management to analyse local community satisfaction. Applying the concept of consumer satisfaction in analyzing community satisfaction with forest management would provide enriched information base for policy decision making. For the particular case of Kakamega forest, there is scanty literature on previous systematic elicitation of the local people's satisfaction with forest management.

In essence community satisfaction with different aspects of forest management reveals underlying perception about the different management approaches. However, more often than not, the perceptions of the local communities about management of natural resources are not systematically elicited, evaluated and incorporated in the decision-making processes (Chase *et al,* 2004). For the particular case of Kakamega forest, there is scanty literature on previous systematic analysis of the local people's perception of existing forest management approaches. The Forest presents a unique opportunity to compare local communities' perception of three existing forest management approaches. Understanding how local communities perceive forest management by external agencies is important for designing management policies that address the dual goal of community interest and conservation

(McFarlane and Boxall, 2000; Trakolis, 2001; Dolisca *et al*, 2007). Apart from forest management aspects, people's perceptions of conservation issues are likely to be influenced by an array of socio-economic, demographic, resource endowment and institutional factors (Hill, 1998; Mehta and Kellert, 1998; Gillingham and Lee, 1999; Racevskis and Lupi, 2006). Gaining an understanding how the forest-adjacent communities perceive natural resource management authorities and factors that condition their perception is crucial for designing targeted policy measures to address people's aspirations in conservation. From the foregoing research problem, the next section highlights the contribution that this study hopes to make to conservation policy debate.

1.5 Significance of the Study

The results of this study will provide useful information to formulate appropriate policies to manage the forest efficiently on one hand and also address the needs of the local people on the other. Specifically, the significance of this study can be stated as follows:

1. Knowledge on the performance of the existing forest management approaches would provide policy makers with information on whether or not they meet the economic criteria of efficiency. This knowledge is important not necessarily for deciding which management approach is better than the other but also in providing information on possible interventions that would enhance the economic efficiency of different management approaches.
2. Information on the distribution of costs and benefits among stakeholders will shed light on the underlying conservation incentive-disincentive structures across the three management approaches. This information is critical for guiding policy design that could induce various stakeholders to act in favor of forest conservation.
3. Understanding the dynamics that underlie the interactions between local communities and the forest management provides wealth of information for policy makers under different management approaches on how their interactions can be influenced in favor of forest conservation.
4. The results of this study can also contribute to the conservation debate at the international level especially on the economic efficiency of forest management as well as management agency-local community interface.

1.6 Study Objectives

The overall objective of this study was to analyse and compare the performance of the three management approaches of Kakamega Forest by use of indices such as economic efficiency, distribution of costs and benefits, community satisfaction and community perceptions.

Specific objectives of the study were:

1. Analyse the distribution of different categories and magnitudes of costs incurred and benefits obtained in conservation and utilization of Kakamega Forest at the local, national and global level under the three management approaches
2. Using the framework of cost benefit analysis, assess the economic efficiency of conserving and utilizing Kakamega Forest under different management approaches at the local, national and global level
3. Analyse the levels of satisfaction of local communities with the performance of the three management approaches of Kakamega Forest and factors that influence them
4. Estimate the relative importance of different aspects of forest management in the overall satisfaction of local communities under the three management approaches
5. Through a factor analysis, assess how local communities perceive or label different management approaches and factors influencing their perceptions

1.7 Sampling and Data Elicitation Procedures

The first step in data collection involves identifying the target population followed by an appropriate sampling procedure for generating a sample. The target population for this study was the forest adjacent community which basically refers to the people residing along the boundary of the forest and its proximity. A reconnaissance survey was carried out before the actual data collection began and it mainly involved informal group and individual interviews with various stakeholders. The aim of these interviews was to obtain the necessary background information about various aspects of forest; e.g. forest extraction, types of products extracted from the forest, human-wildlife conflicts and such other type of information. The reconnaissance survey revealed that there was progressively little interaction with the forest beyond 5 km from the forest edge. Therefore, a decision was

made to limit the scope of the study to within a radius of approximately 10 km radius all around the Forest covering all parts managed by the three management approaches.

As the first formal step in executing this study, a census of households within the study area was carried out with the help of administrative village heads and other local leaders. The census generated a sampling frame which consisted of approximately 34,000 households residing within approximately 10 km radius of the forest. A random sample of 378 households was randomly generated from the sampling frame using Statistical Package for Social Sciences (SPSS) computer program. The sampled households were randomly interspersed in the study area and across the three management approaches. Generating the sample randomly is preferred because it generates a very representative sample hence the results of analysis can be applied to make policy recommendation for the larger population from which they were obtained.

The actual data collection was done via face to face interviews using semi-structured questionnaires that were administered to the sampled households by trained enumerators under the author's direct supervision in the period spanning between September 2005 and February 2006. The enumerators spoke the local language and had previous experience with questionnaire-based data collection. Before data collection began the enumerators were trained for two days to familiarize them with the questionnaire and also to equip them with the necessary interview techniques. The training was followed by one week of pre-testing the questionnaire which was done jointly by the author and the enumerators. The pre-testing helped to improve the content and clarity of the questionnaire (see Appendix 3 for a copy of the final household survey questionnaire). The interviews were carried out with the household head or the spouse. Efforts were made to assure the respondents that the information collected especially personal information as well as information related to forest extraction would be kept anonymous and would not be revealed to the forest management authorities or any third parties. This assurance was particularly important especially for matters related to forest extraction which is a rather sensitive issue in the study area given many cases of illegal extraction. The questionnaires elicited information on households' socio-economic characteristics, resource endowment, farming information,

type of products and quantities they extracted from the forest and costs they incurred, their satisfaction with forest management and other related information. Out of the interviewed households a total of 364 households were included in the final analysis, 14 households were dropped from the sample either due to incomplete responses or internal inconsistency. The final sample distribution was as follows; 220 respondents operated under the FD management, 83 under QCM and 61 under KWS.

As will become apparent in later stages of this dissertation, this study also obtained a lot of data from secondary sources. Data on costs incurred and revenues generated by different management approaches was sourced from the official records of different forest management authorities. Official government documents e.g. National census were also an important source of secondary data on population trends in the study area. Another important source of data was the Kenya Forestry Master Plan (KMFP) which is currently the most comprehensive source of information about forestry sector in Kenya. KFMP was developed during the period between 1991 and 1994 and it provides a framework for forestry development for a period of 25 years. It was prepared by a national steering committee that comprised of government institutions, environmental NGOs, donor agencies, forest adjacent communities and other stakeholders. Several studies were undertaken to assess the key issues and to address specific problems relating to forest plantations, industry, institutional arrangements and natural resource management. KMFP was a source of important information related to value of some ecosystem services and future demand patterns of forest products. The study also relied on complimentary studies carried out under the BIOTA[3]-project for example Iason (forthcoming) on values of ecosystem services such as water regulation and also bequest values and Mugambi (2007) on recreational value of the forest. A recent study by Glenday (2006) in Kakamega forest was an important source of information on the carbon sequestering capacity of the forest.

[3] This study was carried out under Biodiversity Monitoring Transect Analysis (BIOTA-East Africa) Sub-project E13 which addressed socio-economic issues of conserving and utilizing Kakamega forest. Several complimentary studies were carried out under the project. Iason's (forthcoming) was carried out as a PhD study addressing valuation of non-use values of the forest. Study by Mugambi (2007) was carried out as an Msc study which estimated recreational value of the forest using the travel cost method.

1.8 General Characteristics of Sample Households

The mean values of the main socio-economic variables of the sampled households are summarized in Table 1-2 and Figure 1-5. The sample farmers were classified into three groups based on the forest management approach under which they reside. Differences between group means were tested to determine whether there were significant differences between these groups[4]. There were significant differences in some variables across the three groups such as land size, proportion of land area under trees, land area left for grazing, years of formal education, average resident family size, distance from forest, distance to market centers and number of cattle owned.

In general, the sampled household can be classified as small-scale given the average size of 0.97 hectare acres per household. There were significant differences in land sizes between the three groups of farmers; farmers under KWS management approach had the largest land sizes while those under QCM approach had the smallest land sizes. It is also important to note that the main method of acquisition of land in the study area is through inheritance from the parents. Over 85% of the household heads indicated that they had inherited their land from their parents (see Figure 1-5). Therefore, land sizes are bound to continue declining in the foreseen future, and given that most of the people (over 70%) are involved in farming as their main occupation (see Figure 1-5), it can be argued that pressure on land to meet subsistence needs of the people will continue to rise. The increasing pressure on land especially in the face of declining agricultural productivity does not augur well with forest conservation efforts because forest extraction will remain one of the obvious alternatives for the people. It is noteworthy that in spite of having the smallest total land sizes between the three groups, farmers under QCM had the largest proportion of their land

[4] Statistical test for significance between differences was carried out using the t-test as follows: $t = \frac{\overline{X}_1 - \overline{X}_2}{S_{\overline{X}_1 - \overline{X}_2}}$ where X_1 is the mean for Group 1; X_2 = mean for Group 2 and $S_{\overline{X}_1 - \overline{X}_2}$ = the pooled standard error of difference between means

under tree (approximately 22%). This could be viewed as an adaptation to deal with scarcity of fuel wood from Kaimosi forest given its relatively small size.

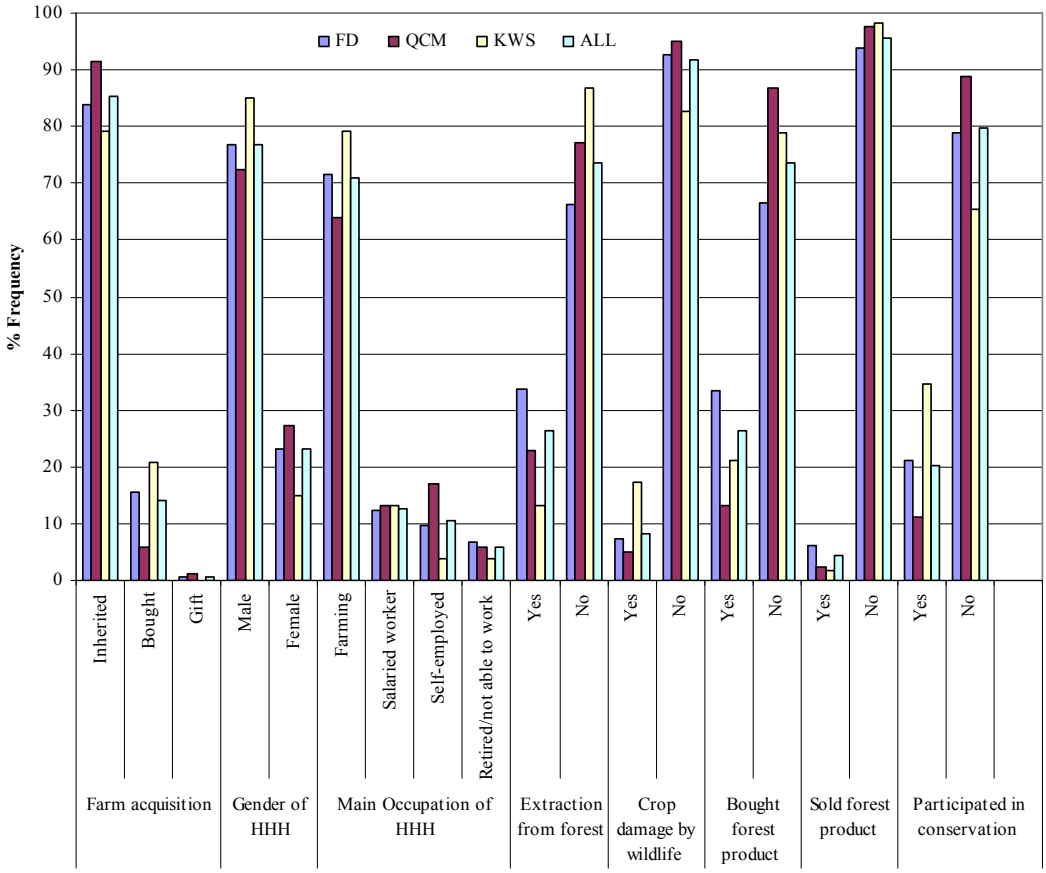
Table 1-2: General characteristics of the sample households

	Overall		FD		QCM		KWS	
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total land size (Ha)	0.97	0.94	0.89	0.75	0.63	0.72	1.83	1.27
Land area under trees Ha	0.11	0.14	0.09	0.13	0.14	0.12	0.11	0.16
Land area for grazing	0.17	0.23	0.15	0.26	0.13	0.12	0.26	0.21
Age of household head	51.02	15.02	50.09	15.10	52.43	15.73	52.30	13.51
Years of formal education	7.79	3.83	7.43	3.62	8.80	4.20	7.69	3.83
Years of farming experience	20.67	13.55	19.85	13.47	21.12	13.36	23.14	14.00
Average resident family size	5.77	2.20	5.78	2.15	5.61	2.35	6.96	2.21
Shortest distance to the forest edge (km)	2.17	2.10	2.38	2.06	0.90	0.87	3.38	2.61
Distance to the nearest market center (km)	1.98	2.13	2.12	1.20	1.09	1.28	2.82	3.08
Number of cattle owned by households	2.34	1.98	2.51	2.21	1.91	1.06	2.20	1.84

Source: Own Survey, 2005/06

The average number of years of education for the household heads in the area is relatively low. An average of 8 years of formal education means that most farmers do not have any education beyond the elementary level while some do not have any formal education at all. Therefore, they have limited opportunities to get employed in the non-farm sector or to successfully run commercial enterprises. However, it is worthwhile to note that farmers under the QCM management approach had significantly higher level of education than those of FD management approach (see Table 1.2).

Fig. 1-5 Frequency distribution for selected variables of sample respondents



Source: Own research survey, 2007

There were significant differences among respondents in the three approaches with regard to the nearest distance to the forest. On average, QCM respondents were closest to the forest while those of KWS were furthest. On average, the sampled farmers were living within 2 km radius of the forest which is a walking distance to the forest. This has significant implication on the ease with which the local people can access the forest and consequently extract or over-extract from it. Similarly, there were significant differences between the sample households in relation to distance to market centers. On average, households under QCM were closest to market centers while those under KWS were furthest. Average resident family size was approximately six individuals per households, but households under KWS management approach had significantly higher family sizes

compared to households under FD and QCM groups. The level of commercialization in forest products is relatively low; overall about 20% of the respondents indicated that they bought at least one product from the forest. About 20% of the respondents indicated that they participated in forest conservation activities such as tree planting or attended forest conservation related meeting.

1.9 Organization of the Dissertation

This dissertation is organized into six Chapters: Chapter 2 lays out the theoretical and conceptual background of the study. Chapter 3 presents the analysis of costs and benefits of conserving Kakamega forest as well as the economic efficiency of the three management approaches. Chapter 4 presents the analysis of local community satisfaction levels with the three management approaches and factors influencing them. Chapter 5 analyses the perceptions of the local communities of the management approaches and the factors that influence these perceptions. Lastly Chapter 6 summarizes the findings of the study and discusses their policy implications and further highlights insights for future research.

2.0 THEORETICAL AND CONCEPTUAL BACKGROUND

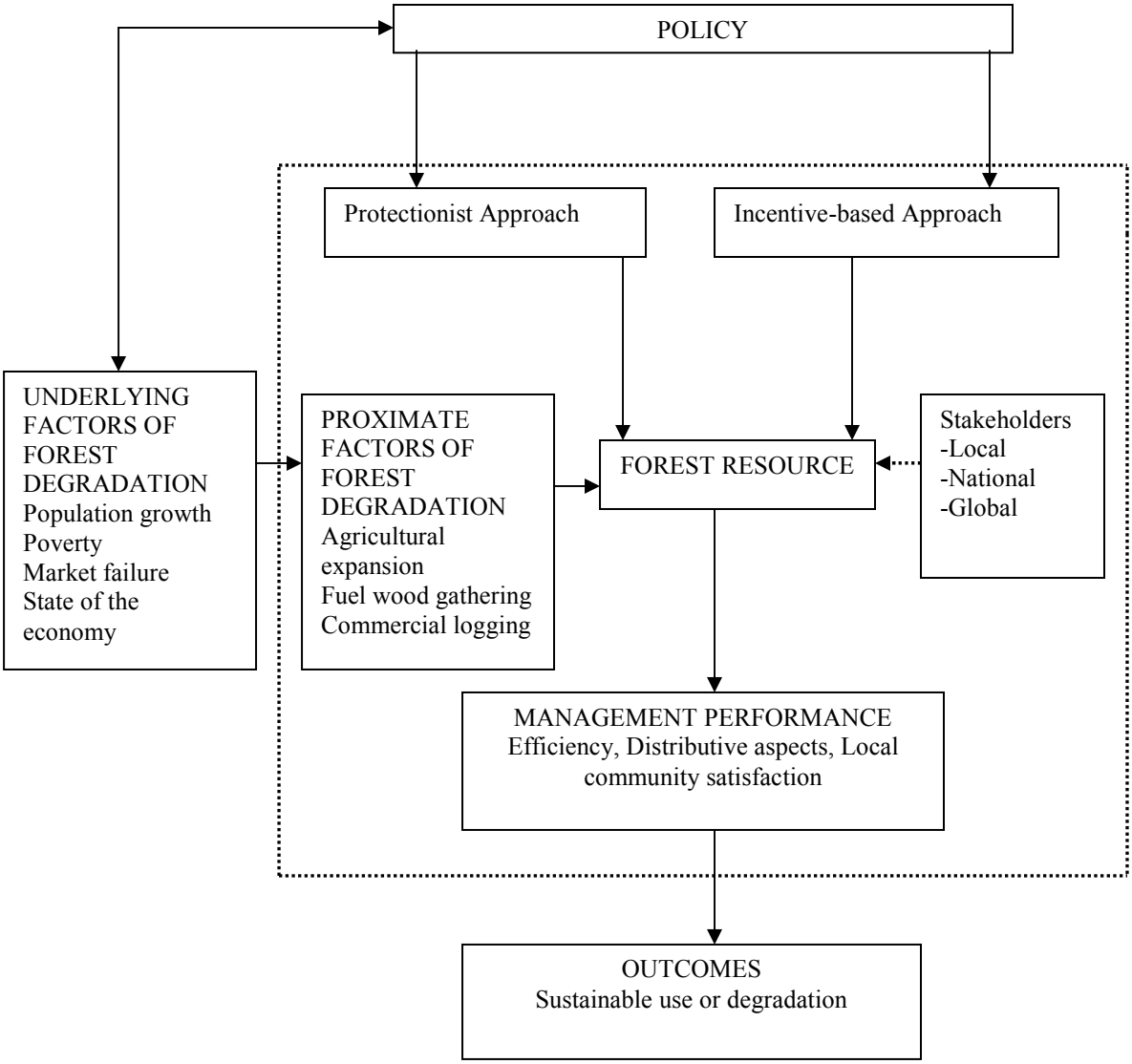
2.1 Introduction

The overall aim of this Chapter is to outline and discuss the theoretical concepts that underpin the study. The Chapter begins by giving an overview of the conceptual framework that was adopted for this study in Section 2.2. The conceptual framework basically shows the interplay between forest management approaches and other aspects such as drivers of forest degradation and interests of different stakeholders and how it ultimately influences management performance indices. This is followed by a description of paradigms of nature conservation highlighting their particular relevance and application to Kakamega forest in Section 2.3. Under Section 2.4, the concepts and approaches of valuing benefits and costs of nature conservation are discussed while in Section 2.5 the concept of cost-benefit analysis and its application as a decision-making tool in conservation is discussed in detail. In Section 2.6 the concept of consumer satisfaction as applied in marketing research is explored. Further, the section discusses how the concept was adapted to capture satisfaction in the context of forest management while Section 2.7 gives a summary and conclusions of the Chapter.

2.2 Conceptual Framework

The conceptual framework adopted for this study is schematically summarized in Figure 2-1. The two broad approaches of public forest management i.e. protectionist or incentive-based emanate from the existing government policy. These management approaches when applied in the utilization and conservation of forests, determine the resulting management performance indicators such as distribution of costs and benefits among the various stakeholders (at local, national and global level), economic efficiency, local community satisfaction and ultimately the outcomes in terms of sustainable use or degradation of the forest. These management approaches do not operate isolation but rather in the context of other 'external' factors such as proximate and underlying drivers of degradation as well as interest of different stakeholders with the forest resource being the focal point. For the purposes of this study the underlying factors of degradation are not specifically considered since they are largely beyond the scope of the current study.

Fig. 2-1: Schematic representation of the conceptual framework



Source: Authors' Conceptualization, 2007

Distribution of costs and benefits among stakeholders is a key indicator of the performance of a management approach because distributive effects of management directly shape the incentive-disincentive structure for or against conservation among the stakeholders (Pagiola *et al,* 2004). This study will attempt to validate the proposition that a management approach does influence the net benefits accruing to various stakeholders from the process of utilizing and conserving the forest. From the preceding proposition, it is plausible to assume that the levels of net benefits accruing to the local communities (being major stakeholders), will have a direct bearing on their satisfaction levels with a given

management approach (Gadd, 2005; Walpole and Goodwin, 2001). This is because the very existence of the forest denies the local community the opportunity to use the forest land for other purposes, farming for example. Any net benefits that they obtain from the forest, could somewhat "compensate" them for the "loss" they incur because of forest conservation. However, the foregoing argument may not necessarily hold especially where there is lack of transparency and accountability in implementing the extraction rules by the management authorities. A study carried out by Mehta and Kellert (1998) in Nepal found that despite being allowed to extract from the forest, local communities expressed negative attitudes towards the forest management because of double standard in enforcement of rules. Therefore, the community satisfaction with forest management is considered to be influenced not only by the direct net benefits accruing to them, but also by the performance of management in applying rules of extraction fairly and transparently.

The main driving force behind natural resource (forest) degradation is the underlying discrepancy between private and social costs and benefits arising from conservation and utilization of natural resources (Pearce and Moran, 1994). Private costs and benefits refer to the losses and gains perceived by the 'immediate users' of the resource while social costs and benefits are the losses and gain that accrue to the wider 'society' either at regional, national or even global level. Generally, social costs and private costs do not coincide and therefore, what is good for the private individual may impose costs on the society i.e. individual users generate negative 'externality' to the wider society. For individuals who live near forests, the returns from cutting trees for timber or converting the forest to farm land is often financially more attractive, because benefits accrue directly to them but for the society as a whole it is more beneficial to conserve the forest (Wiggins *et al*, 2004). The immediate and direct factors that drive forest degradation e.g. clearing forest for agricultural land, logging e.t.c. constitute the proximate group of factors. However, there are underlying or ultimate factors such as high population growth rate, high levels of poverty, market failure and such others that drive the observed proximate factors and are more complex to manage.

There are several groups of stakeholders in the conservation of natural resources based on the type of benefits or cost they obtain/or incur from the resource or other vested interests in the process of conservation and utilization of the resource. In general, these stakeholders operate at different levels; at the local level, local communities i.e. the forest adjacent people are the main stakeholders. Others include the local non-governmental organizations (NGO's) with interest in conservation or community-based organizations (CBO's). At the national level, the state is the main stakeholder while the 'international community' consists of all individuals or organization at the global level with interest in conservation. These different stakeholders have different forms and levels of interactions with the forest resource. The local communities have the most direct interaction with the forest resource mainly because many of them depend on it for their basic needs such as fuel wood for cooking. Local communities also bear relatively high cost of conservation by incurring the forgone cost of utilizing the forest for agricultural purposes. The state is also a very important stakeholder in conservation because it possesses nearly all the property rights over the forest resource and incurs nearly all management costs of conservation. Furthermore, it has the ability to make policies that would decisively determine the trends of conservation hence it plays the role of a pacesetter for the other stakeholders. The global stakeholders play a vital role in influencing government policies e.g. international conventions such as the CBD require the signatory states to implement certain conservation measures. The global community also has the potential to provide compensatory funding for the local communities and also for research purposes. Therefore, gaining an understanding on how these different groups of stakeholder share out the costs and benefits of conservation can shed light on the underlying incentives for conservation or disincentives against it. This information is particularly important as an input for designing appropriate conservation policies for the forest.

2.3 The Paradigms of Nature Conservation

Conservation debates are dominated by two broad criteria for prioritizing nature conservation. These criteria are both based on different perceptions of "value". Value can be defined as the contribution of an action or object to user-specified goals, objectives or conditions (Farber *et al*, 2002). One criterion argues that nature should be conserved

because it has an intrinsic value independent of human use i.e. nature has right to exist. The alternative criterion is utilitarian in nature and it argues that nature should be conserved because it is important for human use i.e. it provides good and services that are essential for human life. The latter approach is anthropocentric in nature and fits well with economic principles of allocating scarce resources among alternative and competing uses. It contends that conservation is costly and economic tradeoffs will inevitably arise between its objectives and other societal needs. For example setting apart resources to fund conservation of a forest means that those resources are unavailable to meet other societal needs e.g. building roads. Therefore, understanding the full costs and benefits of conserving nature becomes an important tool for guiding conservation policies (Edwards and Abivardi, 1998; Hanley and Spash, 1993). This study takes cognizance of the fact that there are other approaches to assigning value to nature (based on eco-centric arguments) but it adopted the anthropocentric approach to analyse the economic performance of the existing management approaches of Kakamega forest. This is because economic value represents a very important value of a forest resource which cannot be ignored in making conservation decisions.

Historically, conservation strategies have been dominated by attempts to fence off or reserve areas for nature and exclude people from the reserved areas (Adams and Hulme, 2001). This protectionist model has been labeled the 'fortress conservation', 'coercive conservation' or 'fence-fine' and for a long time it dominated international thinking about conservation. It involved the creation of protected areas (national parks, game reserves and national forest reserves) and exclusion of people as residents, and prevention of consumptive use and minimization of other forms of human impact. Broadly, this approach viewed development objectives of local communities as being in direct conflict with the objectives of biodiversity conservation. For long period of time, this approach influenced conservation efforts in Sub-Saharan Africa both during colonization and continues to do so even in the post independence days. It is widely accepted that protected areas in different forms will continue to play a major role in conservation world wide in the foreseeable future (Brown, 2002). In fact, today, about 70% of world forests are still owned and administered by governments (White and Martin, 2002). However, in most cases the top-

down exclusionary approaches to protected areas have not been successful in preventing deforestation and the associated loss of forest biodiversity which has become one of the major conservation challenges facing the world today (Geist and Lambin, 2002; Tucker, 1999). A recent study based on satellite imagery indicates that between 1990 and 1997 the annual rate of global deforestation of humid tropical forests averaged over five million hectares per year (Achard *et al*, 2002). Protectionist-exclusionary approaches of natural resource management have been found to be contradictory to concepts of sustainable development because they do not enhance equity and in most cases they impoverish the rural poor communities (Adams and Hulme, 2001).

In recognition of the problems associated with the fortress approach a new discourse has arisen that stresses the need to incorporate the needs and aspirations of the local people in conservation processes. Unlike fortress conservation that viewed people as a 'threat' to conservation, the new approach views them as potential partners in biodiversity conservation. This approach has two distinct elements: first, it allows people in the vicinity of the protected area or others with property rights to participate in the conservation process and second, to link the objectives of conservation with the local development needs of the people (Hutton and Leader-Williams, 2003). This approach recognizes the moral implications of imposing costs on local people and the pragmatic problem of hostility of displaced or disadvantaged local people to conservation organizations practicing fortress conservation strategy (Adams and Hulme, 2001). The approach adopts sustainable development concept and combines both biocentrism and anthropocentric arguments in conservation. The approach looks at the opportunities for combining income generation with conservation and considers strategies such as non-forest based enterprises, ecotourism, domestication of forest products and agricultural intensification (Wollenberg, 1998). Under this approach, the state transfers (with varying degree from case to case) some property rights to local communities to allow them to take a more active role in conservation efforts. However, where it has been applied, incentive based approach has not necessarily resulted in invariably positive outcomes (Agrawal and Gibson, 1999). It has been observed that the success or failure of decentralization depends on a mixture of context and case specific institutional and socio-economic factors (Matose, 2006; Agrawal and Gibson, 1999). At

best the results have been mixed; success has been recorded in some cases but in most cases it has resulted in failure. This has led to a growing discontent with the results of community ownership of natural resources and some studies have even proposed that a reversal to the state management should be considered (see Buscher and Dietz, 2005 for an example).

As noted earlier in Chapter 1, the bulk of Kakamega Forest (except the QCM managed part) was first subjected to state control in the 1930's, followed by its total transfer from the local communities to the central government in 1964. Over the years the central government has given some concessions to the local people over the use of the forest but it remains largely a protected area. However, as noted in the Chapter 1, the current management of Kakamega forest is not uniform but has a mixture of different approaches operating alongside each other. Some parts of the forest are strictly protected while others are under incentive-based management.

2.4 Valuing Economic Benefits and Costs of Nature Conservation

The total economic value (TEV) of forest biodiversity can be broadly categorized into use and non-use values (Pearce and Moran, 1994) as summarized in Table 2-1. Use values arise from actual use made of a given natural resource. Use values are divided into direct use values such as logging; indirect use values which refer to actual uses such as ecosystem functions like watershed protection, and option value, which is a value approximating an individual's willingness to pay to safeguard a resource for the option of using it at a future date (a sort of insurance value). The indirect use and non-use values are a bit more complicated in definition and estimation. Non-use values are divided between bequest value and existence or passive values. Bequest values are benefits accruing from any individual from the knowledge that others might benefit from the resource in the future while existence values arise simply from existence of a particular resource and not necessarily for use purposes. For example an individual might have concern to protect the Mountain Gorillas in the Congo even though he/she has never seen them or is likely to see them in future.

Table 2-1: Categories of benefits attributed to environmental assets

Use Values			Non-use values	
Direct-use values	Indirect-use values	Option value	Bequest value	Existence Value
Outputs that are directly consumable Examples: Food, Recreation	Functional benefits Examples: Flood control, nutrient cycles	Future direct and indirect values	Use and non-use values of environmental legacy	Value of knowledge of continued existence

Source: Pearce and Moran, 1994

Valuation of ecosystem is not a single activity and as noted by Pagiola *et al,* 2004, the simple question of 'how valuable is an ecosystem' can be interpreted in several different ways. It could be interpreted as asking about the value of the current flow of benefits provided by that ecosystem, or about the value of future flows of benefits. It could also be asking about the value of conserving that ecosystem rather than converting it to some other use. These interpretations of the question are often treated as being synonymous, but they are in fact very different questions, and the answer to one will not be correct as an answer to the other. From the forgoing argument, the procedural conduct of economic valuation in the context of natural resources depends on the policy question under consideration. As noted by Pagiola *et al,* (2004) there are four distinct aspects of valuing ecosystems; the first aspect involves determining the total value of flow of benefits from an ecosystem. This questions mainly arise in the 'national accounts' situation about how much ecosystem services contribute to the national economy. The second aspect involves determining the net benefits of interventions that alter the ecosystem services. This question typically arises in a project or policy context; would the benefits of a given regulation or incentives justify its costs? This question in contrast to the earlier one asks about the changes in flows of costs and benefits rather than the sum of total value of flows. In essence it does not refer to the value of the stock, but rather the change in a stock compared with their alternatives, e.g. with a forest *vis a vis* with a farming system. The third aspect involves determining how the costs and benefits of ecosystem conservation are distributed. This is important because different groups often perceive different costs and benefits from an ecosystem. It can help in gaining understanding about which groups are motivated to conserve or destroy an ecosystem and the reasons why they do so and therefore it can help in designing more

effective conservation policies. The fourth and the last aspect involve identifying potential sources of conservation funding by identifying the beneficiaries of conservation and the magnitude of benefits they receive, which helps in designing mechanisms to capture some of these benefits and avail them for conservation. The four procedural aspects of economic valuation of ecosystem services are summarized in Table 2-2.

Table 2-2: Approaches to environmental valuation

Approach	Why it is done	How it is done
Determining the total value of the current flow of benefits from an ecosystem	To understand the contribution that ecosystems make to society	Identify all mutually-compatible services provided; measure the quantity of each service provided; multiply by the value of each service
Determining the net benefits of an intervention that alters ecosystem conditions	To assess whether the intervention is economically worthwhile	Measure how the quantity of each service would *change* as a result of the intervention, as compared to their quantity without the intervention; multiply by the marginal value of each service
Examining how the costs and benefits of an ecosystem (or an intervention) are distributed	To identify winners and losers, for equity and practical reasons	Identify relevant stakeholder groups; determine which specific services they use and the value of those services to that group (or changes in values resulting from an intervention)
Identifying potential financing sources for conservation	To help make conservation financially sustainable	Identify groups that receive large benefit flows, from which funds could be extracted using various mechanisms

Source: Pagiola *et al,* 2004

This study concentrates on the second and third aspects by comparing how the performance of the three management approaches of Kakamega forest influence changes in benefits that arise from the forest and which costs are related to each. In essence the question of valuation in this study attempts to understand how the intervention of the three different management approaches alters the flows of costs and benefits and whether they are economically viable. In addition the study also compares the distribution of costs and benefits across the three management approaches.

Depending on the level that benefits occur, they can further be distinguished into local, national and global benefits. However, as noted by Mburu and Birner (2002), it is

sometimes difficult to identify which share of a given conservation benefit should be attributed to each level due to obvious overlap of some conservation benefits but the general practice is to assign benefits to the level where they proportionately accrue most. In the particular case of Kakamega forest, most of direct use benefits accrue to the local communities while indirect non-use benefits accrue both at local and national level. However, there are some exceptions; the bulk of recreational benefits from the forest accrue at the national and global level while carbon sequestration benefits are mostly global.

An array of methods exists for eliciting the economic value of environmental good and services. The methods can be classified into two broad categories i.e. those that are based on primary studies using either revealed preference methods or stated preference methods and those that are based on secondary sources where benefit transfer is used to infer value of a resource without directly eliciting it (See Table 2-3). Revealed preference methods are based on market prices and are particularly relevant for valuing environmental goods and services that are directly traded in the market or those for which a market proxy exists. In economic valuation, market price of a good or service is normally the best estimate of its marginal value and of its opportunity cost, and most often it will be the best price to use in valuing either costs or benefits (Gitinger, 1982). In general, the direct use values of an environmental resource are the easiest to measure because they involve observable quantities of products whose prices are observed in the market place. This study used market prices to measure the value of directly extracted products of Kakamega forest such as fuel wood, fodder, thatch grass and charcoal because quantities extracted could be approximated from the proportion of extracting population and the market prices were easily available in the local markets.

Stated preference methods generate the willingness to pay (WTP) or willingness to accept compensation (WTA) values for the goods or services being valued. WTP reflects the maximum amount of value (in money terms) of a good that an individual is willing to give up to get more of another good while WTA reflects the minimum amount of value (in money terms) of a good that an individual is willing to receive to get less of another good.

Table 2-3: Main economic valuation techniques for environmental goods and services

Method	Approach	Applications	Data requirement	Limitations
Revealed preference methods				
Production function	Impact of change in ecosystem services on produced goods	Any impact that affect produced goods	Change in service, impact on production, net value of goods produced	Data on change in service and consequent impact on production is often lacking
Cost of illness, Human capital	Impact of change in ecosystem services on morbidity and mortality	Any impact that affect health	Change in service, impact on health, cost of illness or value of life	Function linking environmental conditions to health is lacking, value of life is difficult to estimate
Replacement costs	Cost of replacing lost good or service	Any loss of good or service	Extent of loss of goods or services, cost of replacing them	Tends to over-estimate actual value
Travel cost (TCM)	Derive demand curve from data on actual travel costs	Recreation	Survey to collect monetary and time costs of travel to destination, distance traveled	Limited to recreational benefits, hard to use when trips are to multiple destinations
Hedonic pricing	Effect of environmental factors on price of goods that include those factors	Air quality, Scenic beauty Cultural benefits	Prices and characteristics of goods	Requires vast quantities of data; very sensitive to specification
Stated preference methods				
Contingent valuation (CV)	Asking the respondents directly for their WTP or WTA for a particular service	Any service	Survey that presents scenarios and elicits WTP or WTA for specified service	Many potential sources of bias in responses
Choice modeling	Asking respondents to choose their preferred option from a set of alternatives with particular attributes	Any service	Survey of respondents	Similar to those of CV, analysis of data generated is complex
Other methods				
Benefits transfer	Use results obtained in one context in a different context	Any for which suitable comparison studies are available	Valuation exercise at another similar site	Can be inaccurate because many factors can vary even for similar contexts

Source: Pagiola *et al,* 2004

As noted by Pearce *et al,* (2006), traditionally, economists have been fairly indifferent between using WTP or WTA, but over time literature has focused on WTP. However, the

recent development of stated preference methods has repeatedly discovered divergences between WTP and WTA. These differences would not matter if the nature of property right regimes were always clear (Pearce *et al,* 2006). WTP in the context of a potential improvement is linked to status quo while WTA for the loss is the relevant measure in the context of loosing status quo. Since environmental policies tend to deal with improvement rather than degradation of the environment, WTP is presumed to be the right measure. WTP and WTA are related to the two Hicksian measures of consumer welfare changes i.e. compensating surplus (CS) and equivalent surplus (ES). Compensating surplus is the payment that will make the individual indifferent between the original and the new quantity of the environmental good under consideration. On the other hand, equivalent surplus is the income change required to keep the person consuming the old quantity, if he/she has the right to the new situation. For an environmental improvement, CS is the WTP for the change occurring and ES is the WTA compensation for change not occurring. For an environmental deterioration, CS is the WTA compensation for the change occurring and ES is the WTP for the change not occurring.

In certain cases where comparison is suitable, benefit transfer method can be used to transfer value to a resource based on valuation results of a similar resource from a different but similar context. Three main techniques of benefit transfer are commonly applied i.e. direct benefit transfer, adjusted benefit transfer and value function transfer (Ready and Navrud, 2005). In direct benefit transfer a constant benefit value is used per unit of the unpriced good. It is best suited for situations in which impacts of a project can be measured in a fairly homogeneous manner e.g. value of a statistical life lost. Adjusted benefit transfer as the name suggests involves adjusting for differences between the original site of study and the new site to which benefits are transferred e.g. differences in income. Value function transfer is applied where there are measurable differences in the good or population between the study sites and the policy site. In essence it predicts the value of a good as a function of it measurable characteristics, those of its users and the context in which it will be produced. The value of a good in the policy site is obtained by adjusting for the specific measures of the site. Whatever method is chosen, extreme caution should be applied

because results are likely to be different even in similar contexts due to differences in other contextual factors (Morrison and Bergland, 2006).

Data requirements for valuing ecosystem services are substantial and the linkages between these services are difficult to determine. Watershed protection service, associated soil conservation benefits and carbon sequestration were identified as the main ecosystem services generated by Kakamega forest. Watershed protection service is critical because the forest prevents soil erosion which prevents soil entering into rivers Isiukhu and Yala and ultimately into Lake Victoria where it would cause siltation and alteration of the marine habitat for aquatic life. The forest also carries out an important role in regulating water flow by conserving rain water in its ecosystem. Forests can regulate greenhouse gases by fixing carbon dioxide contributing to decrease in the green-house effect and hence global warming. Given the complexity of these benefits, it was beyond the scope of this study to generate the value of these ecosystem services. The values for these services were sourced from complimentary study that was carried out alongside this study (Iason, forthcoming) as well as secondary sources, mainly from studies carried under the Kenya Forestry Master Plan (KFMP, 1994); as well as other sources for example (Glenday, 2006; Pearce, 2001). It is rightly argued that benefit transfer is inherently inferior to conducting original studies mainly due to the high likelihood of transfer error i.e. the difference between the transferred value and the true (but unknown value) for the policy site. In spite of its limitations, given limited time and budget, benefit transfer offers a fairly good guide for valuing resources. There are some indications in literature that transfer errors tend to be smaller when two goods are located in the same region (Ready and Navrud, 2005). Benefit transfer values that were applied for this study were obtained from studies carried out within fairly similar and comparable geographical sites in Kenya. More detailed description of this values and how they were elicited is provided in Chapter 3, Sub-Section 3.2.2.

From an economic point of view, forest conservation is only one of the many land-use options. Economic principles require that socially optimal land use pattern be chosen so as to maximize the present value of societal welfare. At the margin, the returns from

sustainable forest management should compete with those of alternative land use such as agriculture (Bulte *et al*, 2000). The forgone benefits from using the forest land for alternative purpose(s) constitute the opportunity cost of conservation. As noted by Norton-Griffiths and Southey (1995), economic case for conservation could be compromised if opportunity costs are not fully considered when calculating net returns from nature conservation. More often than not, opportunity costs of conservation exceed the more obvious management related costs, and are largely borne by the local communities (Balmford and Whitten, 2003).

For the communities' living around the forest, the main opportunity cost of forest conservation is the net foregone opportunity to use forest land for farming (Mburu and Birner, 2002; Norton-Griffiths and Southey, 1995; KFMP, 1994). For the particular case of Kakamega forest, the average net income from smallholder agriculture based on prevailing agro-ecological and farming systems was considered in estimating opportunity costs. Further details on how opportunity costs were calculated for Kakamega forest are provided in Chapter 3, Sub-section 3.2.4. Apart from the opportunity costs, several other categories of costs are incurred in the utilization and conservation of the forests. The managing authorities incur different types of fixed costs and recurrent costs. Fixed costs consist mainly of capital costs e.g. purchase of motor vehicles, buildings and such others. Although such costs are incurred as one time expenditure in a long span of time, the depreciation costs can be used to approximate the annual rate of use (based on wear and tear) of such capital goods. On the other hand recurrent costs are incurred annually and consist mainly of items such as staff salaries, office stationery expenditures, fuel cost and such other day-to-day expenditures that are incurred in the process of management of the resource. From the perspective of the local communities, extraction labor costs are an important component of costs that they incur in the utilization of the resource. Other related costs include conservation activities related costs such as time spent in attending conservation meetings and transaction costs that are incurred in the search for information about forest products and bargain costs in the process of buying or selling forest products. In this study, transaction costs were especially considered because for a long time, economic theory had assumed that typical economic decisions are determined by production and distribution

costs, prices and market structure alone, ignoring the costs involved in making transactions (Hubbard, 1997; Mburu and Birner, 2002; Zhang, 2001).

It is important to note that benefits and costs in the context of environmental resources are realized over a long span of time. It therefore becomes imperative to consider the temporal dimension of streams of costs and benefits for informed decision-making. In essence, the future is uncertain but using the currently available information from a variety of sources, it is possible to project likely future scenario(s) of flows of costs and benefits. Cost-benefit analysis (CBA) provides a framework for decision-making in situations that involve present and future flows of costs and benefits. The framework provides for the possibility of discounting future flows of costs and benefits to determine their present values and make the appropriate decision. The next section discusses the procedures of applying CBA in the context of environmental conservation.

2.5 Cost-benefit Analysis and Its Application in Nature Conservation

As noted by Pearce *et al* (2006 p. 42), the theoretical foundations for CBA can be briefly summarized as follows:

a) The preferences of individuals are to be taken as the source of value. To say that an individuals' well-being, welfare or utility is higher in state A than in state B is to say that the individual prefers A to B.

b) Preferences are measured by a willingness to pay (WTP) for a benefit and a willingness to accept compensation (WTA compensation) for a cost[5].

c) It is assumed that individuals' preferences can be aggregated so that social benefit is simply the sum of all individuals' benefits and social cost is the sum of all individuals' costs.

d) If beneficiaries from a change can 'hypothetically' compensate the losers from a change, and have some net gains left over, then the basic test that benefits exceed costs is met.

[5] Note: The notions of WTP and WTA can be extended to include WTP to avoid a cost and WTA to forgo a benefit

The last theoretical concept (d) above is the Kaldor-Hicks principle of potential compensation which states that if the gainers from an action *could* compensate the losers, the action is an improvement regardless of whether compensation is actually paid. This implies that provided that compensation *could* occur then no one is actually worse off, hence the Pareto-criterion for improvement in overall well-being. It is clear from the foregoing argument that actual compensation need not occur in reality, but it is potentially conceivable. If compensation is actually paid, the principle is actually the Pareto criterion (Hanley and Spash, 1993). In situations in which benefits and costs occur over a span of time, economic analysis require that the present value of benefits (discounted at an appropriate discount rate) exceeds the present value of costs[6] and an inter-temporal compensation is conceivable.

CBA involves comparing net benefits based on with and without proposed project/activity comparison so as to eliminate the possibility of overestimating the net benefits that result from a proposed project or activity. In case of conservation of a forest the benefits arising from conservation are compared to the base scenario i.e. the forest land is used for an alternative purpose for example farming. In essence converting forest into agriculture would result in loss of biodiversity, in reduced watershed protection, carbon sequestration capacity, loss of recreational benefits but on the other hand it leads to increase in food production or money income which partly compensates for the loss of other services. To effectively capture the incremental benefits due to a given intervention for instance forest management, benefits arising from such intervention have to be compared with what would occur without intervention.

By applying the principle of potential compensation, CBA fails to explicitly account for distribution of benefits in the society. There have been some attempts to integrate distributive issues in CBA by applying weighting factors to benefits or costs to reflect the

[6] The Criteria of Net Present value (NPV) is based on this requirement and is computed as follows: NPV= $\sum_{t=1}^{n} \frac{(B-C)_n}{(1+i)^n}$ where n is the number of time periods, i is the discount rate and B and C are benefits and costs respectively.

income of individual affected (Pearce, 1998). The theoretical arguments for these weights are based on the declining marginal utility of income i.e. the utility an individual gets from an extra unit of income is higher, the lower his/her present income. As noted by Pearce (1998), these attempts are not widespread possibly because of intensive data requirement or the view that distributional issues are not best addressed through project investments. The prevailing feeling among the CBA practitioners is that inclusions of equity goals fall outside the realm of economics (Hanley and Spash, 1993). Although cost-benefit analysis is not specifically designed as a tool for evaluating equity, the analyst has the possibility to track the distribution of costs and benefits among the various segments of society. In the particular case of forest conservation, distribution of costs and benefits between the forest adjacent communities and the society as a whole is very important given that the local community bears the bulk of opportunity costs of existence of the forest i.e. the forgone net benefits of using the forest land for farming.

As noted by Hanley and Spash (1993), carrying out a CBA proceeds through several stages that are outlined in detail below;

i. Identifying the resources being reallocated in a given project or activity as well as the gainers and the losers in that process. At this stage, the boundary of the analysis is set out; in the case of Kakamega forest as in any case of establishment of a protected forest area several resources are reallocated. Land, capital, cash and labor are the main resources allocated. Local communities being the previous owners of the forest are the first losers in the reallocation process. The nation also loses because it has to allocate resources to protect the forest by incurring the management costs e.g. paying forest officers and guards
ii. Identifying the economically relevant impacts of the project/activity implementation. The total economic value (TEV) approach of valuing the forest was applied in identifying the positive impacts of the forest conservation. The costs were identified by identifying the stakeholders and then investigating the types of economically relevant costs they incur.
iii. Once the impacts are identified they are grouped into positive impacts (benefits) and negative impacts (costs).
iv. The identified impacts are physical quantified and assigned a monetary value. At this stage the magnitudes of benefits and costs are measured and then relevant valuation procedures

are applied to obtain their monetary values. For comparison purposes all the costs and benefits were expressed in common units, that is US $/ha of forest land.

v. The decision criteria are applied once the net benefits are discounted. This stage begins by projecting or simulating future flows of costs and benefits and then discounting them using a relevant discount rate and then applying the decision criteria. For example if NPV criterion is chosen, then forest management approach that generates positive NPV is considered economically viable. Several other criteria such as Internal Rate of Return (IRR) or Benefit-Cost ratio can also be applied. If IRR is the criteria of choice, the project with the largest IRR above cut-off rate is chosen but the main challenge is that many projects can give multiple IRR's from the same data set and cannot decide among many projects. This study applied the NPV because it intuitively reflects societal behavior where decisions about future flows of costs and benefits are considered. Any course of action is judged acceptable if it confers a net advantage that is, if the present value of benefits outweighs the present value of costs.

vi. Finally, sensitivity analysis is carried out to capture the different possible scenarios. For example a different discount rate, time frame or policy scenarios.

It important to note that depending on the perspective from which it is carried out, CBA can take two forms; financial or economic. Financial CBA is carried out from the perspective of an individual stakeholder e.g. the local communities and market prices are applied for valuing costs and benefits. On the other hand, economic CBA is carried out from a societal point of view and costs and benefits are valued at their shadow values. Further discussion on the two CBA models are discussed under Sections 3.4.1 and 3.4.2 for financial and economic CBA respectively. One advantage of CBA is that it enables the researcher to take into account the time dimension of cost and benefit streams an aspect that is ignored in the comparative static frameworks (Mburu and Birner, 2002). However, this also poses the challenge of projecting or simulating the future flow of cost and benefits especially in forest use. In essence the knowledge of the future is at best uncertain and at worst unknown; therefore any future simulations are based on assumptions about key parameters such as dynamics of forest degradation/regeneration, population growth, demand for forest products, government policy towards conservation and such others.

Further detail on how future benefits and costs simulations were done is explained in Chapter 3, Section 3.3.

Application of CBA in environmental management is faced with a number of challenges. Many environmental goods and services are not traded directly in the market hence the difficulty of attaching a monetary value to them. As noted earlier however, researchers have attempted to address this challenge by formulating various non-market methods of valuing environmental goods and services for example contingent valuation, travel cost method, hedonic pricing and such others. Another eminent challenge of applying CBA to environmental management is the complexity of ecosystems being valued as well as irreversibility and uncertainty of some decisions arising from CBA results. CBA results incorporate sensitivity analysis to provide policy makers with options under different scenarios. It is important to note that conservation decisions are made at political level and therefore economic consideration provide one piece of information among many pieces of information necessary for decision-making.

The concepts of discounting and the choice of a discount rate have been noted to be a major item of controversy in carrying out CBA (Kumar, 2000; Hanley and Spash, 1993). This is mainly because of the implications of discounting for benefits and costs which accrue in the distant future. Decisions about implementation of the project with long-term benefits or costs often depend on the choice of discount rate. The process of discounting implies that the longer the time in future that costs and benefits are realized, the less they are weighed and the higher the discount rate, the higher the time bias. From an economic perspective, discount rate is the rate at which society weighs future consumption against present consumption, or by which it attaches a social time preference to consumption by its members. The process of discounting is defended by economists as reflecting the way people value things. Based on the positive rate of time preference (for both consumers and producers) and the opportunity cost of capital (for producers) the future is treated as less important than the present. In practice the choice of the discount rate is the onus of the researcher guided by various considerations such as the discount rates applied for government agencies (Lockwood *et al*, 1993), the length of the project time considered

(Kniivila *et al*, 2002) opportunity cost of capital in the country/area of study (Mburu and Birner, 2002) or other such like criteria. The choices of discount rates for financial and economical CBA are further discussed in Sections 3.4.1 and 3.4.2 respectively. Another important consideration in CBA is the time horizon considered for the project or activity. From the perspective of the local people, the most relevant time horizon is the part of their lifetime that they are likely to benefit from the project. The time horizon chosen for this study is discussed jointly with simulation of future flows of costs and benefits in Section 3.3.

2.6 Concept of Consumer Satisfaction and its Application in Forest Management

In the recent past consumer satisfaction studies have been gaining importance beyond their traditional marketing circles, with applications in health services (Fredrik and Jostein, 2000; Margolis *et al*, 2003) and recreational services (Akama and Kieti, 2003; Whisman and Hollenhorst, 1998) but are not widespread in the context of natural resource management. The theory of consumer satisfaction as applied in consumer research studies can be adapted to analyse the satisfaction levels of local communities with services offered by forest management authorities. From this perspective, forest management approaches are viewed as providing 'management services' while the local communities as 'consumers' of these services. A study by Andersson (2004) provides an example of assessing communities' satisfaction with forest management in the municipal provision of forestry services in Bolivia. The first step in generating these satisfaction levels is to clearly define the services offered by forest management; as outlined in their mandates in legislation or mission statement and secondly by use of an appropriate elicitation procedure obtain the satisfaction ranking of the local communities with the services offered.

In order to analyse it, consumer satisfaction has to be defined and conceptualized in a way that captures the actual people's assessment of the performance of forest management approaches. As noted by Giese and Cote (2002), several definitions of satisfaction are found in literature without necessarily one single consensus definition. However, as highlighted by Giese and Cote (2002) in spite of differences in definition, there are three

common elements of consumer satisfaction; first, it is a response (either emotional or cognitive), secondly it pertains to a particular focus (expectation, product/service, consumption experience and such others) and thirdly it occurs at a particular time (after consumption, after making a choice or based on repeated interaction). In this study we defined satisfaction as the evaluative judgment of the respondents about the performance of forest management based on their repeated interaction in line with several other studies that have defined satisfaction in the same way (Fornell, 1992; Mano and Oliver, 1993; Tse and Wilton, 1988).

Consumer satisfaction with a product or a service can be captured either through aggregate (single-item) or attribute (multi-item) level of measurement. Multi-item level measurement of satisfaction attempts first to capture consumer satisfaction toward specific aspects or dimensions of the service or product in question and then aggregates them into an overall satisfaction score. The main weakness with aggregation is that the researcher has to arbitrarily assign weights (or assume equal weights) for the different attributes of the service or product. In contrast, an aggregate measure inquires only about a consumer's overall or global satisfaction with a product or service. The aggregate measurement subsumes the attribute measurements and one presumption, therefore, is that the two assessments-aggregate and individual attribute would yield similar estimates of overall satisfaction. However, the two measures are more likely to diverge especially when consumers engage in partial satisfaction assessment (satisfaction assessment based on evaluation of only some of the features) or where consumers weigh some attributes more highly than others and the researcher has no priori knowledge about the consumer weighting. Aggregate measure allows consumers to impose their weighting criteria on the elements before responding with an overall assessment of satisfaction (Szymanski and Henard, 2001). Attribute by attribute ranking can be used to analyse how the respondent weighs the different attributes of the product or service with respect to overall ranking. In addition consumer ranking of different attributes of a product or a service can be analysed to reveal how consumers perceive the product or service in general terms by use of factor analysis (FA).

This study elicited both the overall satisfaction as well as satisfaction with different forest management attributes. The overall satisfaction with forest management was elicited by asking the respondents to rank their overall satisfaction with the way the forest closest to their residence is managed based on five satisfaction levels (1=very satisfied, 2=satisfied, 3=neutral, 4=dissatisfied, 5=very dissatisfied) as espoused in five different water levels in a drum (See appendix 1). These satisfaction ranking were regressed against a set of respondents' socio-economic, demographic and resource endowment characteristics to analyse which factors influenced them (the procedures are further described in Chapter 4) Apart from the overall satisfaction, the respondents were also asked to rank their satisfaction levels with 16 other attributes of forest management. The relative importance or weights of different forest management attributes to the overall satisfaction were determined using an approach similar to conjoint analysis (further details are provided in Chapter 4). Further, these attributes were assumed to also measure some underlying latent 'views' that represent the local communities' general perceptions towards the three management approaches. Factor analysis was carried out to map out these perceptions and further regression analysis was carried out to determine which factors influenced them (see Chapter 5 for detailed analysis).

2.7 Chapter Summary

This Chapter laid out the theoretical background for analyses presented in subsequent Chapters 3, 4 and 5. The Chapter began by outlining the conceptual framework which stresses the important role of forest management approaches in influencing the outcome of forest use. The framework places the management approaches in the wider context of government policy and factors that determine outcomes of forest use. The main focus of the framework is the role of forest management approaches in determining the management performance indicators; economic efficiency, distributive aspects and local community satisfaction and perception. The concept of economic valuation is laid out next with the aim of showing which valuation methods were applied for this study. Later on the Chapter laid out the theoretical background of cost benefit analysis and consumer satisfaction. The next three Chapters present analytical procedures, results and discussion of the findings of the study.

3.0 COST-BENEFIT ANALYSIS OF EXISTING MANAGEMENT APPROACHES OF KAKAMEGA FOREST

3.1 Introduction

In this Chapter different categories of benefits and costs that arise from conservation and utilization of Kakamega forest under the three management approaches are discussed and later analyzed using the framework of CBA. Section 3.2 provides an overview of different costs and benefits accruing to different stakeholders at the local, national and global level. Section 3.3 provides a detailed discussion on the projections and simulation of likely future patterns of flows of costs and benefits based on information from the survey and a variety of secondary sources. Under Section 3.4 the empirical models of CBA that were applied for this study are described. The results of CBA are presented and discussed in Section 3.5 while Section 3.6 presents and discusses the results of sensitivity analysis. The summary of this Chapter and its conclusions are given in Section 3.7.

3.2 Overview of Costs and Benefits of Conserving Kakamega Forest

As explained earlier in Chapter 2 (Section 2.3) this study closely followed the TEV approach to assess the effect of management approaches on benefits arising from utilization and conservation of Kakamega forest. Different categories of benefits derived from Kakamega forest are discussed in the subsequent Sub-sections 3.2.1 to 3.2.3. Sub-section 3.2.4 provides a detailed discussion of costs that are incurred in the conservation and utilization of Kakamega forest.

3.2.1 Direct Extractive Benefits

The results of the survey showed that local communities extracted various kinds of products from the forest including fodder/grazing, firewood, charcoal and thatch grass in order of financial magnitudes on an annual basis. These products were valued at the prevailing prices in the local markets (summarized in Table 3-1). Total value of extraction benefits were obtained by scaling-up the values from the sample households to the population of forest adjacent community based on the percentage of extracting households for different products. As noted in Chapter 1 (Section 1.6), there were approximately

34,000 households in the study area. Based on their location around the forest the households were distributed by management authorities as follows; 25,000 households were under the FD managed part; 2,900 under the QCM and 6,100 under the KWS.

Table 3-1: Local market prices of non-timber forest products harvested from Kakamega forest

Product	Unit of measurement	Price per unit	
		Ksh	US $[7]
Firewood	Head lot	50	0.67
Thatch grass	Bale	60	0.80
Charcoal	90-Kg Gunny bag	300	4.00
Fodder/Grazing	Cattle grazing/day	20	0.27

Source: Own Survey, 2005/06

For ease of comparison across the management approaches, benefits were ultimately expressed in per hectare of forest basis (US $/ ha) by dividing the total monetary value of product extracted by the area of the forest (based on territorial forest boundaries). As expected there were differences in the values of direct extracted products across the three management approaches. In absolute terms the protectionist approach of KWS offered the least benefits in terms of directly extracted products while the incentive based management of FD generated the largest amount of benefits for the local people. However, it is important to note that in relative terms the quasi-private incentive-based approach of QCM generated the highest extractive benefits per unit area of the forest due to the small size of the forest in comparison to the number of people extracting from it. Details on how the financial values of the direct benefits were calculated are provided in the subsequent paragraphs.

Firewood was the most frequently extracted product with a total of 92 households (equivalent to 25 % of the sample respondents) indicated that they collected some firewood from the forest. In the study area, firewood is an important energy source for cooking because the other alternatives such as charcoal, liquefied petroleum gas or paraffin are

[7] During the time of study 1 US $ exchanged for about 75 Kenyan Shillings (Ksh).

relatively more expensive. Ideally the people are only allowed to collect dead and fallen tree branches but not to cut live trees. Firewood harvested from the forest is removed from the forest in the form of head lots (see Figure 3-1 below). The average price of a head lot like ones shown in Fig 3-1 was approximately Ksh 50 (US $ 0.66) in the local markets during the time of study.

Fig. 3-1: Head lots of firewood harvested from Kakamega forest

Source: Own photography, 2005

The average annual value of extracted firewood was approximately US $ 76 per household. There were some differences on the value of firewood harvested by households across the management approaches as summarized in Table 3-2. Households under FD extracted a higher value worth of fuel wood compared to those under QCM and KWS. However, from the perspective of area of forest harvested (on per hectare basis), QCM forest generated much higher value of firewood than the rest mainly due to the small size of the forest compared to the number of households that extracted from it (see Table 3-2).

Table 3-2: Calculating annual financial value of firewood harvested across management approaches

	FD	QCM	KWS
Average head lots harvested per trip	2	3	2
Average harvest trips per month	8	7	6
Average number of harvesting months per year	10	8	9
Average value of harvested firewood Per year (US $)	88	72	69
Proportion of extracting respondents in the sample	0.3 (66/220)	0.24 (20/83)	0.10 (6/61)
Total number of extracting households	6165	696	610
Total value of firewood extracted by all the households (US $)	656,818	49,950	42,950
Average value of firewood per ha of forest	32.84	384	9.55

Source: Own survey, 2005/2006

The FD and the QCM allow the local people to graze their animals in the forest at a fee. Figure 3-2 shows cattle being taken for grazing in the forest. As noted in the introductory Chapter, the small and declining land holding in the study area has led farmers to set aside relatively small parcels for grazing. Therefore, farmers have to look for alternative ways of feeding their animals and grazing in the forest is one of the available alternatives. Among the extracted products, grazing/fodder had the highest value per unit of forest area which concurs with a previous study by KIFCON (1992). The high value of grazing can be explained by decreasing grazing area in the farmlands due to high population density which has pushed up the value of fodder and grazing land. The findings of the study indicate that local people grazed an average of 4 cows in the forest per household for an average of 27 days in a month. Financial value of grazing was valued using the price of substitute fodder in the study area i.e. Napier grass. Napier grass is the most common fodder crop that farmers use to feed their animals.

Fig. 3-2: Cattle being taken for grazing into Kakamega forest

Source: Own Photography, 2005

An active market for Napier grass exists in the study area and a bundle of Napier grass enough to feed a cow for a day costs about Ksh 20. Overall, the total value for grazing was approximately US $ 786, 558 per year for the whole forest adjacent community around Kakamega forest. Similar to other forest products, there were observable differences in the value of grazing obtained across management systems with FD generating the highest value followed by QCM. None of the interviewed households indicated that they grazed in the KWS managed part of the forest. The calculations for the financial values of grazing under FD and QCM are summarized in Table 3-3.

Table 3-3: Calculation of annual value of grazing from Kakamega forest

	FD	QCM
Average number of cattle grazing in the forest	4	4
Average number of grazing days per month	28	30
Average number of grazing months per year	11	10
Average value of grazing per year (US $)	338	304
Proportion of respondents in the sample who grazed	0.11 (25/220)	0.02 (2/83)
Total number of households who grazed	2260	58
Total value of grazing extracted by all the households (US $)	765,435	17,632
Average value of grazing per ha of forest	38.27	136

Source: Own survey, 2005/2006

Thatching grass is extracted from the forest and used as a roofing material for the traditional grass thatched houses. It offers a cheaper roofing alternative to the more expensive corrugated iron sheets or clay tiles. Thatch grass is harvested in the form of bundles as shown in Figure 3-3. The market price of one bundle of thatching grass was about Kshs 60 (US $ 0.8) during the time of survey. Thatch grass is not harvested frequently because thatch grass roof can last several years without need for replacement. Among the sample farmers only 4 households indicated that they harvested thatched grass from the forest in the year 2004 from the FD managed part. The total value of harvested thatch grass was calculated by multiplying the amount harvested with the number of harvesting households to obtain the total amount of harvested bundles. Then, the total numbers of bundles harvested were multiplied by the price of one bundle to obtain the total value of bundles harvested by the sample farmers. To obtain the total value of thatch grass obtained by all the households in the study area, the total value obtained from the sample households was extrapolated over the entire population. Therefore, when extrapolated the total value of thatched grass harvested by extracting households in the study area averaged US $ 25, 424 annually. The calculations are tabulated in Table 3-4.

Fig. 3-3: Bundles of thatch grass harvested from Kakamega forest
Source: Own photography, 2005

Some illegal activities such as burning of charcoal and logging take place in the forest despite policing by the authorities. A gunny bag of charcoal like the one shown in Figure 3-4 has a market value of about Ksh 300 (US $ 4) in the study area. Only 7 households indicated that they got some burned charcoal in the forest each obtaining an average of 4 bags in a month. This translates to about US $ 147, 312 for the whole study area (see Table 3-4). Wild fruits are also occasionally collected from the forest. However, only a negligible number of households indicated that they collected any such fruits from the forest.

Figure 3-4: Gunny bags of charcoal

Source: Own photography, 2005

Medicinal plants are also illegally extracted from the forest but very few households indicated that they harvested any medicinal plants from the forest. The local communities have knowledge about various types of plants that have medicinal value. The plants range from small herbs that are harvested whole or barks of trees like the one shown in Figure 3-5 below. Excessive debarking and ringing is responsible for the death of many trees in the forest. There are many instances of illegal extraction that take place in Kakamega forest, most of which are not captured by the management because of the weak policing ability. Figure 3-6 below shows some of the impounded charcoal and wood that was being held by the FD.

Table 3-4: Calculation of annual values of thatch grass and charcoal harvested

Thatch Grass	
Average value of thatch grass bundles harvested by a household per year (US $)	56
Proportion of respondents in the sample who harvested thatch grass	0.02 (4/220)
Total number of households who harvested thatch grass	454
Total value of thatch grass extracted by all the households (US $)	25,424
Average value of thatch grass per ha of forest	1.27
Charcoal	
Average value of gunny bags of charcoal harvested by a household per year (US $)	216
Proportion of respondents in the sample who extracted charcoal	0.027 (6/220)
Total number of households who extracted charcoal	682
Total value of charcoal extracted by all the households (US $)	147,132
Average value of charcoal per ha of forest	7.37

Source: Own survey, 2005/06

Fig.3-5: Illegal Debarking of Trees to Obtain Herbal Medicine
Source: Authors' photography, 2005

Fig. 3-6:Illegally Burned Charcoal & Wood Impounded by Forest Department
Source: Authors' photography, 2005

Overall the financial values of direct non-timber forest products that were extracted from KK forest in the year (2004/05) as captured in the survey are summarized in Table 3-5.

Table 3-5: Financial values of extracted products from Kakamega Forest 2005

Forest product	KWS		FD		QCM		Total	
	Overall (US $)	US $/ha	Overall (US $)	US $/Ha	Overall (US $)	US $/Ha	Overall (US $)	US $/Ha
Fodder/Grazing	-	-	765,435	38.27	17,632	136	783, 066	32.63
Firewood	42,950	9.55	656,818	32.84	49,950	384	748,790	30.69
Charcoal	-	-	147, 312	1.27	-	-	25,424	1.27
Thatch grass	-	-	25,424	7.37	-	-	147, 312	7.37
TOTAL	42,950	9.55	1,447,677	79.75	67,582	520	774,214	71.96

Source: Own Survey, 2005/06

In general the average total value of non-timber products harvested from Kakamega forest averaged about US $ 71.96 per hectare per year. This figure closely coincides with figures generated by other studies in tropical forests areas. The non-timber forest products (NTFPs) values from other studies in tropical forests ranged from as low as US $5 per ha/year in the Brazilian Amazon (Schwartzman, 1989 and Hetch 1992), to a high of over US $100 per ha/year in (Pearce, 2001) with the majority of the values clustered around US $50-70 per ha/year. Typically, the high values correspond to easily accessible forests and vice versa.

Kakamega forest also generates recreational benefits especially through tourist visits due to attractions such as bird watching, nature trails, picnic sites, camping and eco-tourism e.g. boarding facilities in traditional huts (see Figure 3-7). As noted by Hein *et al,* (2006) the total value of recreation service of a resource is obtained by summing the utility gained by visitors to the resource (both actual and potential as generated via WTP) and the net value added by visits to the resource (revenue from tourism minus management costs). At the time of study, KWS and FD had a functioning tourism enterprise but only KWS charged entry fees to tourists. QCM did not have any tourism enterprise and informal interviews with management revealed that they had no immediate plans to initiate it. In the recent past there has been a sharp increase in revenues earned in the KWS managed part. For example between 2000 and 2004 tourism earnings grew from about Ksh 0.5 M to Ksh 3.5 per year (see Figure 3-8).

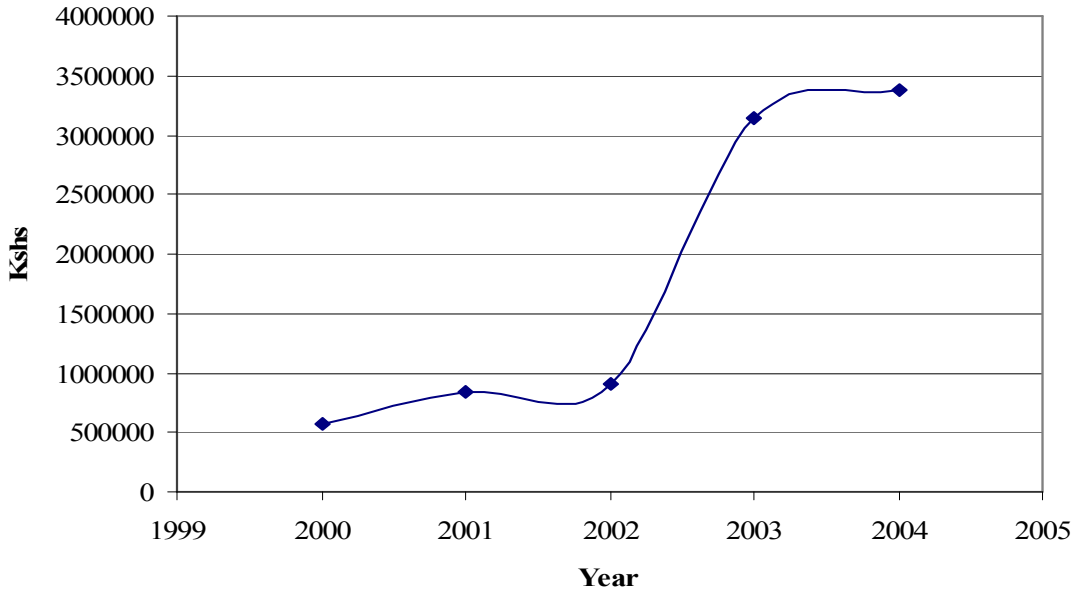
Figure 3-7: Tourists' attractions and facilities inside Kakamega forest

Source: Authors' Photography, 2005

The growth has been mainly due to increase in the number of tourists (mainly international) visiting the forest. A similar pattern of tourism growth has been evident nationwide with earning from tourism increasing by 27% between 2004 and 2005 (KNBS, 2007). This has been attributed to aggressive marketing of the country as a tourist destination by the relevant agencies. As noted by Kambona (2005), the rich biodiversity of Kakamega forest is likely to remain as the main attraction for tourist in the future. The total recreational value of the forest can be obtained by summing up the producer surplus i.e. (gate revenues-management costs) and the consumer surplus (WTP values obtained from travel cost method). The producer surplus mainly accrued at the national level while consumer surplus accrued at the global level because nearly all the tourists who visited Kakamega forest were non-citizens. The recreational value of Kakamega forest was obtained from two sources; the revenues from tourists (gate fees plus other charges e.g. camping) and also WTP values generated from tourists (mostly international) using the travel cost method (TCM). However, the usefulness of TCM in measuring recreational values is limited when multiple destinations are involved. Kakamega forest although becoming increasingly popular with tourists in the recent years does not rank as top tourist destination in the country. Other national parks and game reserves such as Amboseli, Masai-Mara and Tsavo are the main tourist destinations. The study by Mugambi (2007) generated recreational values for KWS and FD managed part of the forest using the zonal travel cost method by classifying visitors

to the forest into country of origin and estimating their cost of travel to the forest based on official records kept by the forest management.

Fig. 3-8: Revenues from tourism in Kakamega forest 2000-2004



Source: KWS Kakamega official records, 2000-2004

The study however did not take into account that visitors to Kakamega forest are most likely to be visiting multiple destinations and therefore the values obtained are at best an overestimation. The study by Mugambi (2007), generated annual values of US $ 3.7 million for KWS and US $ 2.6 million for FD which corresponds to US $ 840/ha per year and US $ 130/ha per year for KWS and FD respectively. In comparison to other studies for tropical forests elsewhere, this value is rather too high. For example Adger *et al* (1995) suggest ecotourism values of US $ 8/ha per year for Mexican forests while Tobias and Mendelsohn (1991) using travel cost method obtained values of US $ 52/ha for Monteverde in Costa Rica. Pearce (1996) suggest values between US $ 5-10 per ha are appropriate for 'conventional' tropical forests. To reflect the level of tourism activities in the different parts of the forest a value of US $ 10/ha was adopted for the KWS managed part (in addition to the value generated through gate collections) while for FD a value of US $ 5/ha was adopted. The QCM managed part was assumed to have no recreational value given that there is no tourism activity taking place and no planned activities in the future. The gate

revenues from tourists averaged about US $ 43,262 annually for KWS managed part while it was zero for the FD managed part.

3.2.2 Indirect Use Benefits

As noted by Aylward and Barbier (1992), most ecosystems contain an endless variety of interlinked and indirectly used functions and therefore judgment must be exercised in selecting the most economically significant uses for valuation. Several indirect use benefits were identified as important for Kakamega forest including; carbon sequestration and water shed benefits including the associated water regulation and soil conservation benefits. A more detailed discussion on their importance and valuation is provided in the subsequent paragraphs.

Concerns regarding global climate change due to emission of green house gases and the associated emergence of global market for carbon credits have led to recognition of the important value of tropical forests as carbon sinks. The continued increase in the atmospheric concentration of carbon dioxide due to anthropogenic emissions is predicted to lead to significant changes in climate (Cox *et al*, 2000). Plants take up carbon dioxide from the atmosphere and store it up in their system; dry plant biomasses contain up to 50% carbon (Glenday, 2006). Compared to other land uses such as agriculture or pasture, standing forests are capable of storing up substantially larger amounts of carbon. It is plausible to assume that smallholder agriculture as is practiced in Kakamega forest sequesters only negligible amounts of carbon because nearly the whole biomass is taken out either for human consumption or by animals hence stored carbon in plant biomass is released into the atmosphere again.

Carbon sequestration has been identified as the largest monetized component of forest services (Pearce, 2001; Chomitz *et al,* 1998). Currently, there exists only a restricted market of tradable carbon emission permits in which the economic value of a margin tonne of carbon traded (tC) ranges between US $ 34-US $ 50 (Pearce, 2001). A better guide to the price of carbon is what is likely to be traded in a free ‘carbon market’. Some studies suggest that if there are no limitations placed on the worldwide carbon trading, carbon

credits will exchange at just under US $ 10 per tC (Zhang 2000) but other studies e.g. Ellerman *et al,* (1998) suggest a minimum price of US $ 35/ ton of carbon in unrestricted market. Given the uncertainty of predicting future prices of carbon, the study adopted a conservative figure of US $ 10 per t C as applied by other conservative studies for example (Naidoo and Ricketts, 2006). It is important to note that the value of a forest to sequester carbon has to be evaluated both in terms of the stock and also at the margin i.e. the stored carbon plus the capacity to sequester additional carbon over time. In the next paragraph the current status of carbon stock of Kakamega forest and its potential to sequester additional carbon is discussed.

Kakamega forest, like other forests generates the benefit of carbon sequestration which is largely realized at the global level. A recent study by Glenday (2006) on the potential of Kakamega forest to sequester carbon found that the mean carbon density in Kakamega was 330 ± 65 t C/ha in the indigenous forest compared to 280±77 t C/ha in the forests' hardwood plantation and significantly greater than that of softwood plantations (250±77 t C/ha). This value was comparable to the mean levels of total ecosystem carbon in comparable tropical ecosystems e.g. Delaney *et al*, (1997) in a Venezuelan study recorded an average of 386 t C /ha. The study found no significant differences between KWS and FD managed part in terms of carbon storage capacities but it did not cover the QCM managed part. The area weighted average carbon density for Kakamega forest was approximated at 106 t C/ha. Differences in total carbon density between plots were mainly as a result of differences in tree biomass (Glenday, 2006). This study assumed that the level of carbon density in the QCM part would be lower than that of FD and KWS mainly due to higher disturbance e.g. fewer tree per unit area and prevalence of planted species than other parts of the forest. A study by Althof (2005) found that the QCM managed Kaimosi fragment had 25% less trees per unit area compared to KWS managed part at Buyangu. Therefore, using the number of trees per unit area as a proxy for capacity to store carbon, it is plausible to argue that the carbon density at QCM managed part would be 79.5 t C/ ha i.e 25% lower than in the rest of the forest. Based on a price of US $ 10 per tonne of carbon, the value of carbon stock currently stored in the forest is approximately US $ 1060/ha for the KWS and FD part and US $ 795/ha for the QCM managed part. The value of stored

carbon in Kakamega forest was assumed to be equally distributed over the years for which CBA was carried out. The marginal increase in carbon sequestration potential of Kakamega forest can only be achieved through forest regeneration especially of the indigenous forest or promoted by re-afforestation of degraded areas and increased protection against extractive use. Based on recent trends, there exists some limited potential for additional carbon sequestration at least in some parts of the forest, for example between 1989 and 2000 there was a 13% increase in tree cover with seventy percent of this resulting from forest colonization of grasslands and open forests, primarily near forest stations which led to an increase of 0.6 t C/ha stored (Glenday, 2006). It could therefore be argued that tree cover could increase in the future especially in the strictly protected areas. An average of 0.5 t C/ha carbon offset is within the range of internationally funded reforestation and forest management based carbon-offset projects in Belize, Malaysia, Mexico and Russia (World Resources Institute, 2002). Even with low speculated carbon prices of US $ 10 per tonne of carbon, a carbon storage project of this size could yield about US $ 5 per hectare of the forest every year over the period of forest regeneration.

In literature, there are two opposing sides of the effect of deforestation on the water regulation; some studies argue that the net immediate effect of tree removal is a rise in water table and therefore a probable increase in dry season flows (Hamilton and King, 1983). The reasoning behind this argument is that trees act as water pumps by removing water from the soil and transpiring it into the air and therefore replacement of trees by vegetation with shallow roots would lower transpiration rates hence reduce ground water loss and raise the water table. However, under certain circumstances deforestation may actually reduce the water table. Bruinjnzeel (1990) point out that processes involved in forest conversion e.g. overgrazing or heavy machinery for land clearance compact the soil and cause gulley erosion which in turn increase run off and decrease infiltration. From the survey, respondents were asked to cite reasons why conserving the forest is important. Over 80% of the respondents cited water regulation as one of the reasons why they thought it was important to conserve the forest. Since water regulation services are not traded in the market, their values can only be obtained by generating willingness to pay through stated preference methods. As noted earlier the values of indirect uses of the Forest were

generated from a corresponding study by Iason (forthcoming) through a choice experience procedure. The study attempted to generate the respondent's willingness to pay for water available to meet the household's needs during the dry season. The average WTP value for water regulation for the whole Forest was found to be Ksh 481 per household per year which translates to US $ 9.2 per ha per year. The forest also plays an important role in preventing soil erosion; the tree canopy slows down the impact of rain drops on the soil hence prevent splash erosion. In addition the roots of the trees hold the soil together hence prevent the soil being washed away by rain water. The value of soil loss prevention to the local communities was generated through WTP to prevent soil loss and it averaged about Kshs 2, 246 per household per year which translated to US $ 42.5/ha per year (Iason, forthcoming).

From a regional perspective, the Forest also generates other water shed protection benefits to the wider society by being an important catchment for important rivers and also by preventing soil erosion and associated siltation in the lower areas. As noted in Chapter 1 (Sub-Section 1.2.1) the Forest is the headwaters for two important rivers; Isiukhu which empties into Yala which ultimately empties into Lake Victoria. There was no data available specifically for Kakamega forest but KFMP (1994) reported an average figure of US $ 37.06 for several major watershed forests in Kenya such as Mt. Elgon and Nandi which fall in the same region as Kakamega forest. Therefore, it was assumed that Kakamega forest would also generate a similar level of watershed benefit like the neighboring Nandi forest. However, it is difficult to assign disaggregated values of water regulation and watershed benefits between different parts of the forest due to data unavailability and the continuous nature of these benefits. Therefore, similar values were assumed for all parts of the forest but Kaimosi fragment was assumed to have no watershed benefits at the national level due to its small size and high degradation levels.

3.2.3 Other Benefits

In addition to direct and indirect use benefits there are non-use benefits that can be attributed to Kakamega forest. As noted earlier these non-use benefits fall into three main groups i.e. bequest and existence values. Bequest values were captured as the value the

local people attach to securing use of the forest in the future[8]. These values were generated as WTP values from a study by Iason (forthcoming) and averaged about Ksh 1,588 per household/year translating to US $ 30.4 per ha /year for the whole study area. Existence values as proxied by the world's willingness to pay for the limited forest areas covered by debts for nature swaps was assumed to be around US $ 2/ ha (Pearce, 1996). Option values are unavailable for Kakamega forest and despite being important they were ignored from the analysis more so because they are unlikely to be influenced by type of management approach chosen. Furthermore, it is plausible to assume that they are not large enough to significantly change the outcome of CBA.

3.2.4 Costs of Conserving and Utilizing Kakamega Forest

Different categories of costs are incurred by different stakeholders in the process of conserving and utilizing the forest. The main cost at the local level is the opportunity cost of forest conservation i.e. the forgone earnings from using the forest land for smallholder agriculture. The value of agricultural and livestock production, in terms of gross revenues, costs and net returns to landowners, is very much a function of land potential: land with good soils and rainfall will produce more than will drier lands with poor soils. As shown by Norton-Griffiths and Southey, (1995), Kenya can be divided into six land potential zones on the basis of elevation, rainfall and temperature - each of which affects crop and livestock production (see Table 3-6).

Table 3-6: Environmental characteristics of land potential zones in Kenya

Zone	Elevation (m)	Rainfall (mm)	Temperature (^{o}C)	Slope (%)	Land Potential
Per humid	2500	>2000	<15	9	Per humid
Humid	1700	1600	15-21	5	High
Sub-humid	1400	1400	21-24	3	Medium
Transitional	1100	700	21-24	2	Arable
Semi-arid	700	600	24-31	2	Ranching
Arid	<700	400	>31	1	Pastoral

Source: Norton-Griffiths and Southey, (1995)

[8] Since bequest values are largely use values they were excluded from the financial CBA to avoid double counting of benefits.

The area around Kakamega forest falls within the humid zone corresponding to the high potential agricultural lands. As noted in the introduction section people living around the forest practice mixed farming; growing a combination of food crops and cash crops as well as keeping livestock. A study carried out by Ryaner (1991) estimated the net returns from smallholder agriculture in the study area to average about US $ 148/ ha per year. This figure is close to the value of opportunity cost[9] reported by Norton-Griffiths and Southey, (1995) for high potential agricultural areas in Kenya at US $ 150/ha per year. An average value of US $ 148 was adopted as the approximate value of forgone annual net benefits per hectare of forest land under all the management approaches. It is noteworthy that opportunity costs are higher than the value of products that local people directly extracted from the forest.

Other local costs consist mainly of extraction labor costs, participation costs (arising from participation in conservation activities), access fees and transaction costs that arise from information search and bargain in buying and selling of forest products. Extraction costs consist of the actual labor cost of extraction, calculated by multiplying the labor time (in hours) spent in extracting forest products with the opportunity cost of time for the extracting individual[10]. Extraction costs represent the second largest component of costs. Participation costs included costs of participating in forest conservation activities both in form of time and cash. Participation costs were obtained by multiplying the time spent in conservation activities with the opportunity cost of participating individuals, plus any direct money spent e.g. transport costs to attend conservation meetings. Transaction costs mainly arise from negotiations and search information in trade in forest products in form of time spent and cash and were found to be even higher than access fees. This is an important observation given that transaction costs are ignored in most cost-benefit analyses. Access fees were the total spending on permit that local people paid to access some selected forest

[9] Considerations were made to use the net returns from the most profitable cash crops grown in the area to approximate the opportunity costs. However, it is somewhat unrealistic to assume that if the Forest is cleared it would be homogeneously put under cash crops. It is more plausible that the forest would be put under smallholder mixed agriculture similar to what farmers are already practicing in their farms; i.e. food crops, some cash crops and livestock keeping.

[10] Opportunity cost of time of the respondent was generated using a hypothetical labour market through a bidding procedure using the prevailing wage as the starting point. See question 4.20 in the household survey questionnaire (Appendix 1)

products, for example, they paid Kshs 20 (US $ 0.27) per month per cow to graze in the forest. Another important component of cost incurred by local communities is the cost of crop damage and livestock injury due to wildlife attacks. As noted earlier on, Kakamega forest is a host to a variety of wild animals some of which move out and damage crops and attack domestic animals such as chicken causing death or injuries. The findings of the survey revealed that baboons were cited as the most frequent culprits. Other cited animals include wild pigs, monkeys, squirrels, and mongoose. The value of crop loss was obtained by multiplying the quantities of crop harvest lost through wildlife attacks by the market prices. Management costs include remuneration costs for staff, office stationery, vehicle operation costs and other equipment costs. The annual management costs incurred by FD and KWS for the period 2003-2005 averaged US $ 269,907 and US $ 62,019 respectively. On per hectare basis this translates to US $ 13.5 and US $ 16 for FD and KWS respectively.

Different categories of costs that are incurred in conservation are summarized in Table 3-7. The costs are expressed in terms of per ha of the forest land by summing up costs over all individuals who incurred them under a given management approach and then dividing it with the size of the forest in hectares.

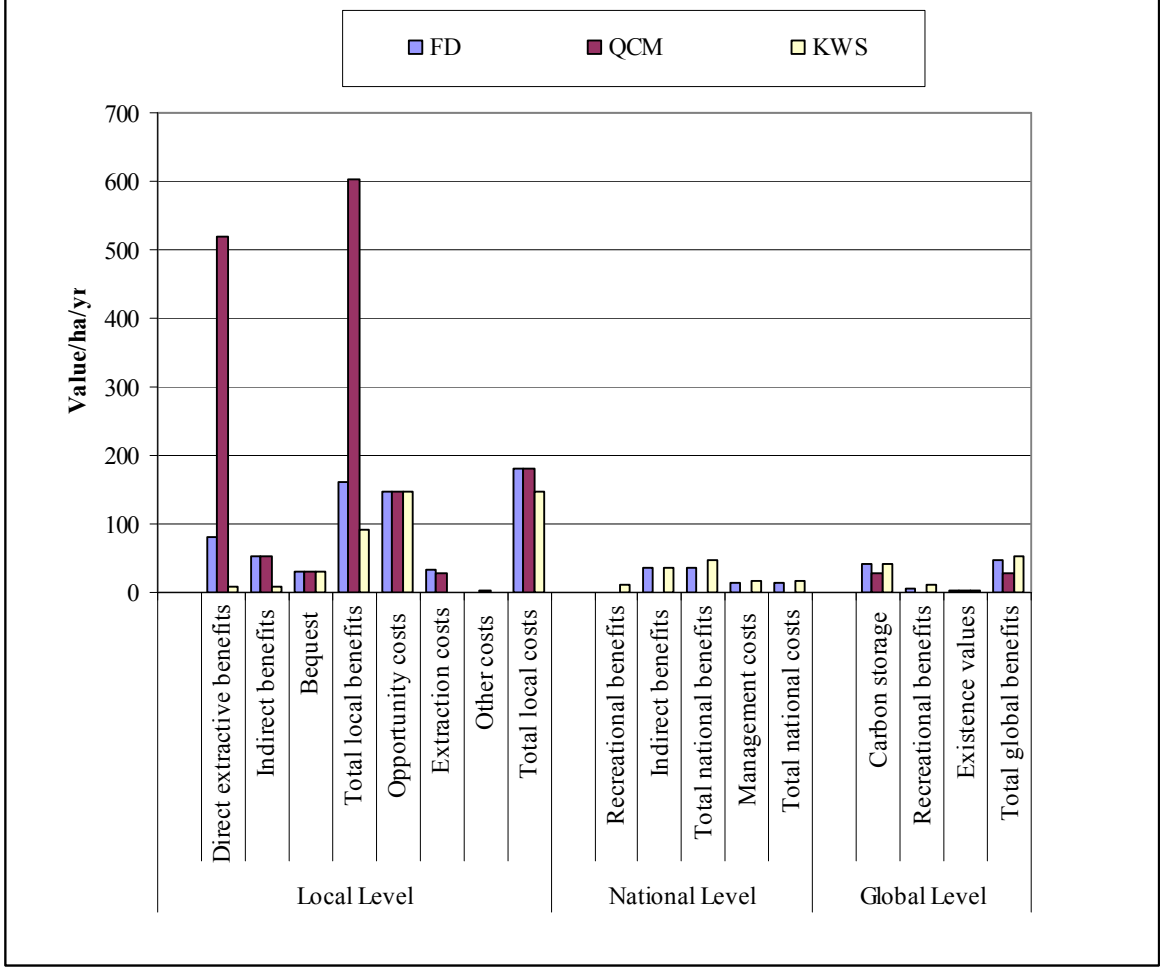
Table 3-7: Annual financial conservation costs

Category of cost	US $/ha		
	FD	KWS	QCM
Opportunity Costs	148	148	148
Extraction labor	32	0.1	29
Transaction Costs	0.2	0.1	2
Conservation participation costs	0.1	0.3	0.4
Access fees	0.2	0	0
Crop loss due to wildlife damage	0.1	0.1	0.2
Management costs	13.5	16	0.1
TOTAL	194.1	164.6	179.7

Source: **Own survey, 2005/06**

Opportunity costs represented the highest percentage of costs that are incurred by the local people in the conservation of the forest. Extraction labor costs were the second largest share of costs that were incurred in the utilization of the forest at the local level. At the national level the bulk of costs include the management costs incurred in financing the operations of FD and KWS. Figure 3-9 below provides a summary of distribution of costs and benefits across the three management approaches at the local, national and global level in the year 2005.

Fig. 3-9: Distribution of costs and benefits at the local, national and global accross the three management approaches



Source: Own Survey, 2005/06

Substantial direct extraction benefits are realized at the local level especially under the two incentive-based management approaches of FD and QCM. However, under FD and KWS management approaches these direct extractive benefits are cancelled out by the higher

opportunity costs. At the national level, the benefits clearly offset the management costs that are incurred under FD and KWS. Similarly, at the global level benefits are realized without any costs beings incurred. However, it is important to note that Figure 3-9 represent a static view of the situation and it is likely to change when the dynamic view is considered as shown in the subsequent sections.

3.3 Simulation of Future Flows of Costs and Benefits

As noted earlier carrying out cost-benefit analysis involves projecting future flows of costs and benefits, discounting them and then applying decision criteria to decide whether a project is worthwhile. In essence however, the future is uncertain and therefore projecting future patterns of costs and benefits is basically guided by assumptions that are made about future scenarios based on available information. In forest-based CBA, like in other environmental based resources, the future state of resource is very central because other parameters such as benefits and associated costs revolve around it. However, this relationship is also affected by other parameters e.g. population growth, the associated demand for forest products, government policy and change in economic conditions. Each of these factors is further discussed in the subsequent Sub-sections.

3.3.1 Future Trends in Population Growth around Kakamega Forest

All the available information indicates that forest adjacent population will continue to increase in the foreseeable future even if the population growth were to slow down a bit in the future. Projections made from the last national census in 1999, indicated that the population for the larger Kakamega district was expected to grow by 43% from 603,422 people in1999 to 861,093 in 2010 at an average annual growth of 3% per year (GoK, 2000). A similar pattern is expected to be observed amongst the forest adjacent communities with a steady increase in the number of households. Beyond 2010, the population growth is unlikely to slow down in any significant way given that most of the population is youthful. The increasing population will continue to exert extraction pressure on the forest and consequently forest regeneration would not be able to match the higher rates of extraction hence declining overall yields from the forest over time. Projections by KFMP (1994) indicate that the demand for fuel wood would grow from 1.07 million tonnes

in 2005 to 1.41 million tonnes by 2020. There is all likelihood that cases of illegal extraction would increase especially in the protected areas of the forest where extraction is currently forbidden. Declining yield per unit of forest area would be associated with increasing extraction labor costs and as forest products become increasingly scarce. Given unavailability of up to date extraction and regeneration data, it is not possible to chart out the exact pattern of decline in forest extraction with increasing population. However, population growth rates and the associated demand for forest products could provide a good guide in projecting likely future flow of benefits from Kakamega forest.

3.3.2 Likely Future Trends in Economic Status of Area around Kakamega Forest

As noted in the introductory Chapter, the economy of Kakamega is largely agrarian with a few associated linkages to other sectors. Over 90% of the population depends on agriculture either directly or indirectly. Growth in the agricultural sector is hampered by stagnant or declining agricultural productivity due to an array of factors such as poor infrastructure, poor access to competitive markets, low technical know-how and such others. Currently there are no signs that the economy of Kakamega is on the threshold of transformation into a modern industrial and service oriented economy. Given high poverty levels and grim economic opportunities, there will be increasing pressure on the forest to meet basic needs. On the positive note the tourism potential of Kakamega forest has been unfolding especially in the last few years especially in the KWS-managed part with the FD´s potential remaining largely underutilized. As noted earlier, there has been a sharp increase in earnings from tourism due to increase in the number of international visitors. The rich biodiversity of Kakamega forest is the main attraction for tourists with main attractions being eco-tourism, bird watching and butterfly watching. This trend is likely to continue in the near future especially with a renewed governments' effort to market western Kenya as a new tourist destination. However, the growth of tourism in the area can only continue as long as the supporting infrastructure such as new attraction sites, hotels, tour guiding facilities continue to grow. Otherwise it is expected to level off at some point in the coming future after the current unexploited potential is exhausted. But more importantly, it will depend on the degradation status of the forest because the main attraction is biodiversity which is eroded or lost as the forest is degraded.

3.3.3 Likely Future Government Policies on Management of Kakamega Forest

The government being the holder of nearly all property rights over the forest could introduce major policy changes that could have a major impact on the forest e.g. major excisions for resettlement purposes or dramatically increasing the policing power of the managing agencies. Assessment of the current trend in government environmental policies and international environmental agreements to which the government is a signatory indicate that the interest in conservation is likely to remain in the foreseeable future. As noted earlier, the government is currently in the process of implementing a new legal framework that would appreciably increase the role of forest adjacent communities in forest management specifically in the FD managed part. It is however, not possible to predict with absolute certainty how this policy will affect degradation status of the forest. Based on the experience of other countries where decentralization has already been carried out, it is difficult to judge the success of decentralization *a priori* because the results have been mixed. In some countries, there has been rejuvenation of the forest with increasing benefits to the local people while in others decentralization has failed in both aspects. The success or failure of decentralization depends on a mixture of context and case specific institutional and socio-economic factors (Agarwal, 2001) but policing ability is a key component in determining success (Agrawal and Ostrom, 1999). The concept of community management is relatively new in Kakamega because it has been over a century since the community managed the forest on their own. In the new dispensation, the government still has the upper hand in management because the local communities have to first organize and form forest management association and then apply for a permit to jointly manage the forest with the government. Most of the enforcement power is still in the hands of the government. It is plausible to postulate that the new management arrangement is unlikely to reverse the degradation trends of the forest in the near future. On the other hand new excisions of the forest are less likely because of the strict controls envisaged in the new law. It is therefore plausible to assume that the current territorial boundaries of the forest would hold in the foreseeable future and degradation trends are likely to remain constant.

3.3.4 Likely Future Trends in the Degradation Status of Kakamega Forest

As noted earlier, Kakamega forest is highly degraded and its current level of extraction is already beyond the sustainable level (KIFCON, 1992). The study by KIFCON indicated that the volume of timber declined from 3.1 million m^3 in 1965 to 1.5 million m^3 in 1991 mainly due to degradation. The study projected that it would take a total of 56 years of total forest protection to achieve the stocking per hectare that existed in 1965 indicating a striking measure of the extent of degradation. However, despite the extensive level of degradation, a closer look at the recent trends in forest cover reveals a rather mixed scenario. The information available from recent satellite images show that overall, between 1989 and 2001 the natural forest cover decreased by 2.1% (Mueller, 2007) but the decrease was not uniform throughout the forest. Actually, within the natural reserves (protected zones) there were some instances of increase in forest cover as shown in Table 3-8 below. All the protected areas i.e. Isecheno, Yala, Buyangu and Kisere had some positive increase in the area under either the natural or secondary forest. However, the overall deforestation was higher than the regeneration observed in the protected parts. Figure 3-10 shows points of degradation in the forest. It is important to note that Figure 3-10 shows only points of degradation and not regeneration i.e. a casual look at the figure could mask the regeneration that took place especially at Kisere and Buyangu.

Table 3-8: Percent changes in forest cover in different parts of Kakamega forest (1989-2001)

Forest Area	% Change in forest cover		
	Natural forest	Secondary forest	Overall
Kakamega (Main block)	-1.9	-0.8	-2.7
Malava	-2.2	-3.9	-6.1
Isecheno	7.1	-6.2	+1.0
Yala	-2.2	2.6	+0.4
Buyangu	1.1	0.5	+1.6
Kisere	-4.8	8.8	+4.1

Source: Mueller, 2007

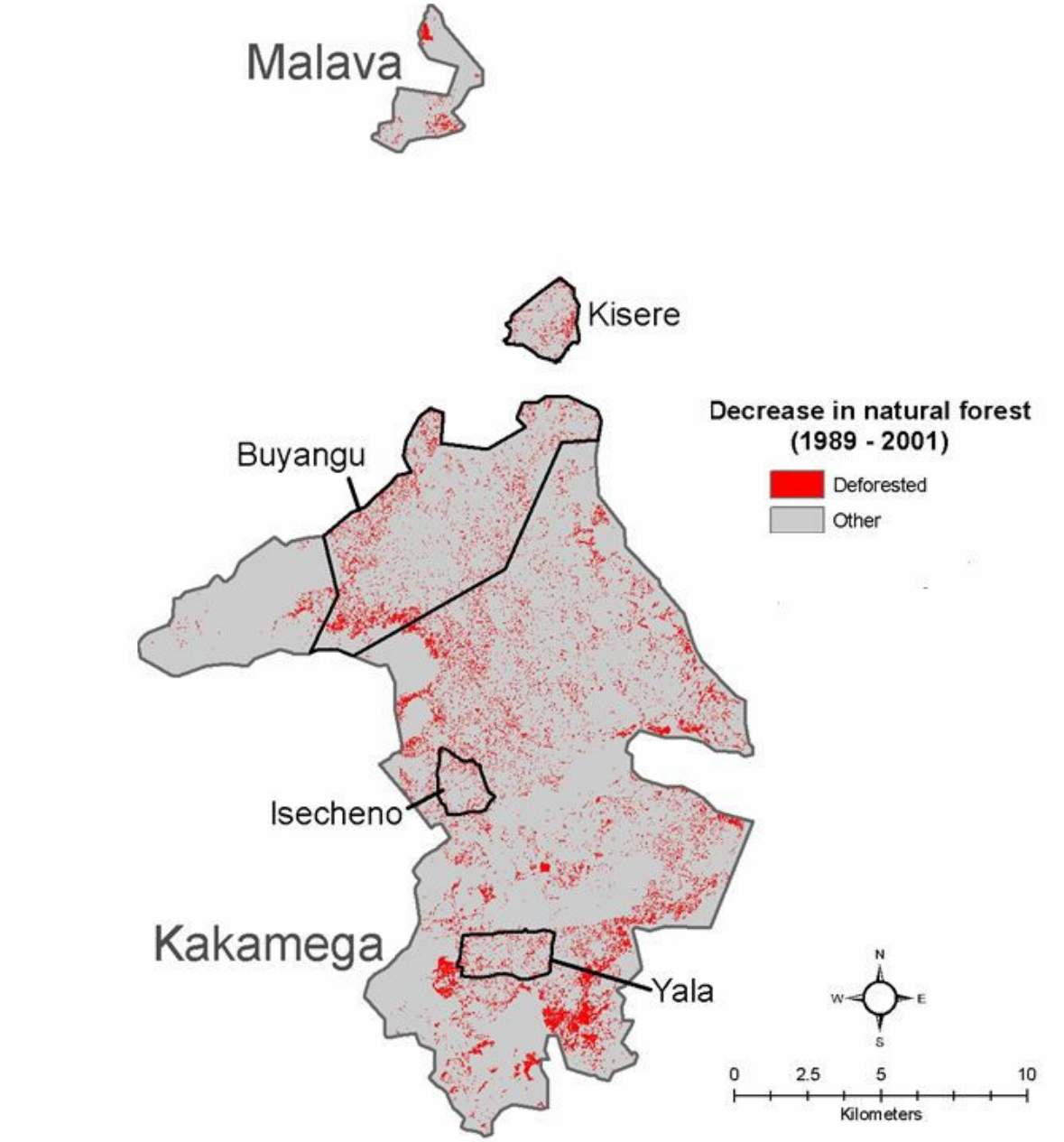


Figure 3-10: Patterns of deforestation in Kakamega forest (1989-2001)

From the Table 3-8, it is possible to differentiate the rates of degradation in the FD and KWS managed part. On average, between 1989 and 2001 the FD managed part lost about 2.7% of its forest cover while in the KWS managed part forest cover increased by a modest

1.9% over the same period. The rate of forest cover change for the QCM managed part for the period between 1989 and 2001 is not available mainly because the official boundaries are not clearly delineated in the GIS maps from which the changes are derived. However, analysis of the level of forest fragmentation clearly indicates that the QCM part suffered the severest fragmentation during the period (Lung and Schaab, 2006)[11]. Assuming the current rates of degradation hold, the area under primary forest would decrease from 10,000 ha in 2001 to 7600 ha in 2037, a decline of 2400 ha in 30 years. Figure 3- 11 to Figure 3-14 traces the projected changes in forested area within Kakamega forest from 2001, 2013, 2025 and 2037 based on the prevailing degradation rates.

Given the prevailing enforcement situation, this study assumed that the current levels of degradation will hold into the time span of the CBA i.e. 30 years. The protected areas of natural reserves are also likely to come under more pressure mainly due to illegal activities that would be exacerbated by inadequate policing capability and population pressure. Based on this assumption, it is expected that direct consumptive and indirect use benefits would continue to decrease every year but they would do so much slower in the protected areas. Determining the exact rate at which they would decrease is an almost impossible task but the annual rate of forest decrease could be a plausible approximation when other factors are held constant. Therefore, the average annual rates of degradation that were observed between 1989 and 2001 were adopted; -0.25% for FD and +0.17% for KWS (positive rate is expected to hold out for direct extractive products due to increasing illegal activities but for ecosystem services it is expected to hold for only some period before turning negative later on). For QCM managed part a higher degradation rate of -0.30 % which is 20% higher than for the FD managed part is postulated.

[11] Based on a forest fragmentation index between 0 (no fragmentation) and 1 (total fragmentation) QCM managed part was reported to score a value of 0.481compared to a score of 0.378 for FD managed part (Lung and Schaab, 2006) this represent a 20% higher rate of fragmentation.

Fig 3-11: Forest Cover in Kakamega Forest 2001

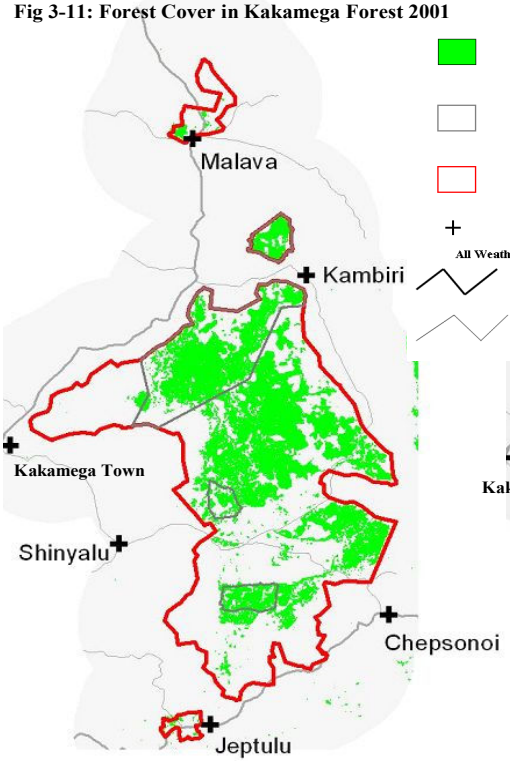


Fig 3-12: Forest Cover in Kakamega Forest 2013

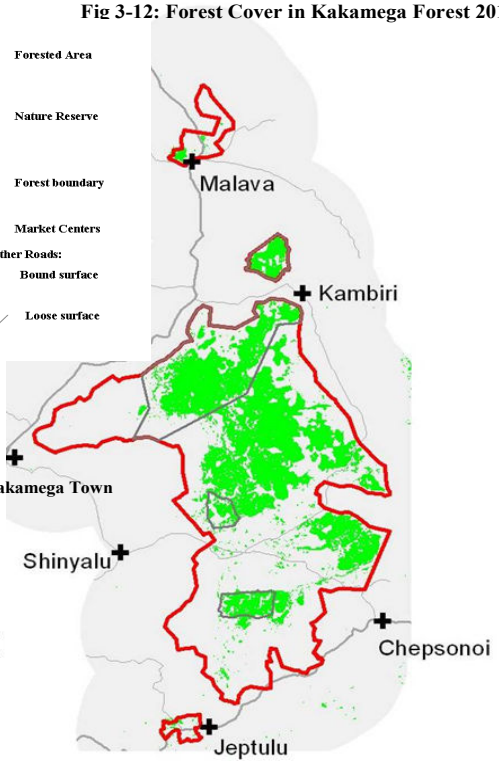


Fig 3-13: Forest Cover in Kakamega Forest 2025

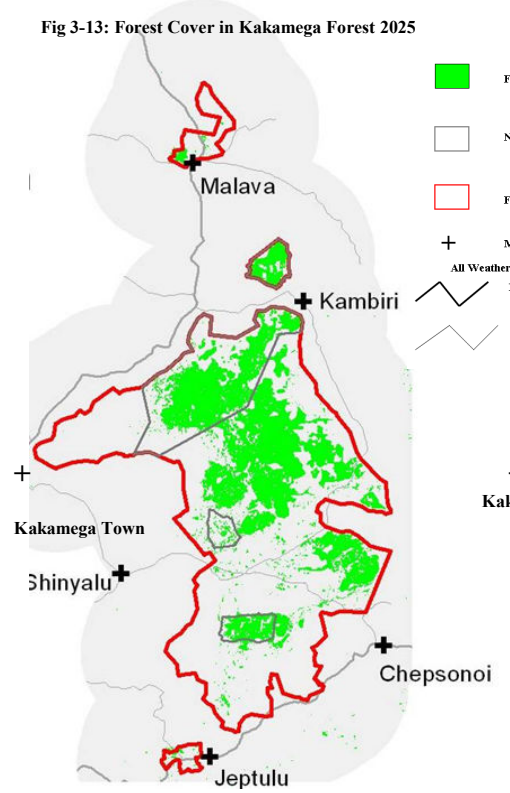
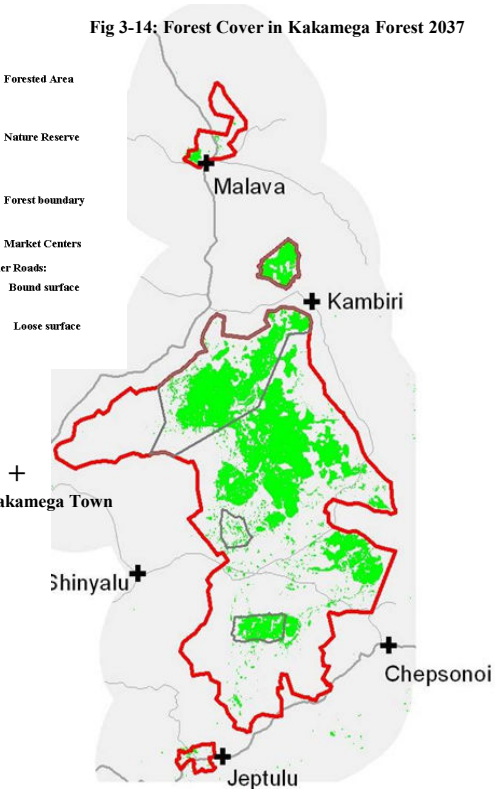


Fig 3-14: Forest Cover in Kakamega Forest 2037



Sources: BIOTA E02, Mueller, 2007

It is also important to note that the deforestation is likely to occur from the forest margins inwards hence people would have to walk further away to extract from the remaining parts of the forest. The projected annual rate of forest degradation (or regeneration) was adopted as the proxy for projecting future flows of benefits from the forest. Further details on assumptions about the CBA models are described in detail in the next Section.

3.4 Empirical Models of Cost Benefit Analysis

As noted earlier, CBA is carried out from the perspective of 'with and without project' comparison to capture net incremental benefit that arise from implementation of a project or activity. In this particular case, the 'with project' is with forest management i.e. under the three different management approaches while 'without project' will be without forest management i.e., the forest is converted into farmland. Since CBA involves projecting future flows of costs and benefits, likely future yield patterns of forest use(s) are an important consideration in carrying out a cost-benefit analysis. As noted in the previous section, there are several likely scenarios depending on the inter-play between important factors. This study considered the most likely scenario; the base scenario based on choice of most conservative parameters while sensitivity analysis was based on critical deviations from the base scenario to test the stability of the results. The assumptions of the base scenario are summarized in Table 3-9. Two closely related CBA models were applied for analysis; financial analysis and economic analysis. The technical structures of the two models are very similar but there are two fundamental differences between them; first, the kind of costs and benefits that are included and secondly how cost and benefits are valued. More details on each model are explained in subsequent Sub-sections below:

3.4.1 Financial CBA

Financial CBA in this study was carried out from the perspective of the local communities. It considered costs they incur and benefits they obtain in the utilization and conservation of Kakamega forest valued at the local prices. Firewood, grazing, thatching grass and charcoal were found to be the most important products that local people obtained from the forest. These products were valued at the prevailing prices for these products in the local markets. The local people also face several categories of costs in the utilization and conservation of

Kakamega forest. These costs consists of extraction labor costs, transaction costs (mainly bargain and information search costs between buyers and sellers of forest products), conservation costs (mainly time spent on tree planting and attending conservation meetings) and access fees paid to extract from the forest. Another important component of cost, is the forgone opportunity of the forest conservation i.e. opportunity costs due to land. Opportunity costs were valued as the net returns from smallholder agriculture as practiced in the study areas as reported by Ryaner (1991) and supported by Norton-Griffiths and Southey (1995). As discussed in Chapter 2 future flows of costs and benefits were discounted at 14% (prevailing local lending rate by formal institutions) to obtain their present value. The local people generally have a higher discount rate than the wider society especially because the benefits directly accrue to them today and the future is uncertain because they do not have full property rights to the forest.

3.4.2 Economic CBA

Economic CBA was carried out from the perspective of the society as a whole. For this CBA the society was divided into two: the nation and the global community based on the level to which particular benefits accrue. Carbon sequestration and recreational benefits were assumed to accrue mainly at the global level. Goods and services are valued at their shadow prices because they are a better indicator of the value of a good or service to the society as whole. As noted by Gittinger, (1982), it is the onus of the researcher to generate shadow prices guided by several considerations. Converting financial prices to economic values involves: (a) adjusting for direct transfer payments such as taxes, direct subsidies and credit transaction (b) adjusting for prices in traded items and finally (c) adjusting for price distortions in non-traded items. Farmers in Kenya enjoy some level of government subsidy on fertilizers but they pay taxes on farm implements and seeds. Therefore, for the opportunity costs to reflect real values to the society they ought to be adjusted upward. Following, Mburu and Birner (2002) this study adjusted the financial value of opportunity costs by 10% to obtain the economic value. Forest products such as firewood, thatch grass and fodder (grazing) are extracted by a relatively large number of people and traded in the local market with many buyers hence it is plausible to assume that their market prices are a good reflection of economic prices. At the societal level main benefits emanated from gate

fees paid by tourists both domestic and international (mainly at the KWS) managed part of the forest. Costs accruing at the national level mainly include; staff emolument, other recurrent and fixed management costs.

Table 3-9: CBA Specification for the base scenario

Parameter	Specification		
	FD	QCM	KWS
Discount rate	Finacial-14% Economic-12%	Finacial-14% Economic-12%	Finacial-14% Economic-12%
Time horizon	30 years	30 years	30 years
Direct extractive[12] Benefits/ha of forest	Decrease at the current rate of forest degradation i.e. 0.25% per year	Decrease at the current rate of forest degradation 1.e. 0.3% per year	Increase at rate equivalent to the rate of forest regeneration i.e. 0.17%.
Direct non-extractive Benefits/ha of forest	Decrease at the current rate of forest degradation i.e. 0.25% per year	Decrease at the current rate of forest degradation 1.e. 0.3% per year	Increase at rate equivalent to the rate of forest regeneration i.e. 0.17%.
Other benefits/ha i.e. option and existence values	Decrease at the current rate of forest degradation i.e. 0.25% per year	Decrease at the current rate of forest degradation i.e. 0.3% per year	Increase at rate equivalent to the rate of forest regeneration i.e. 0.17% for 10 years but begins to decrease.
Local costs/ha	Increase at the rate of 0.5 % because of increasing distance to the forest for extraction and increase in the number of extracting people	Increase at the rate of 0.3 % because of increasing distance to the forest for extraction and increase in the number of extracting people	Increase at the rate of 0.17% because of increasing distance to the forest for extraction and increase in the number of extracting people
Opportunity costs	Remain constant	Remain constant	Remain constant
Budgetary costs/ha	Increase at a rate of 5 % per based on past trends	Increase at a rate of 1% based on past trends	Increase at a rate of 5 % per based on past trends
National benefits (Watershed benefits/ha)	Decrease at the current rate of forest degradation i.e. 0.25% per year	None	Increase at rate equivalent to the rate of forest regeneration i.e. 0.17%.
Tourism earnings	None	None	Increase at 10% annually for 10 years to level off
Carbon sequestration Per ha of forest	Decrease at the current rate of forest degradation i.e. 0.25% per year	Decrease at the current rate of forest degradation 1.e. 0.3% per year	Increase at rate equivalent to the rate of forest regeneration i.e. 0.17%.

Source: Authors' Construction, 2007

[12] Although it is logical to assume that the value of direct extractive benefits would increase with increasing population before declining, the reality on the ground suggest otherwise. As noted in this Chapter, the currently level of extraction is already far beyond the sustainable level Therefore, any extra pressure on the forest can only lead to declining yields per hectare.

3.5 Results of Cost Benefit Analysis: Base Scenario

The results of financial CBA indicate that when opportunity costs are excluded all the three management approaches generate positive net benefits per unit of forest land. However, when the opportunity costs are considered to obtain the incremental net benefit due to conservation, the NPV's become negative under FD and KWS management approaches but remain positive in QCM. This observation could be attributed to the exceptionally high rates of extraction taking place under the QCM managed part due to a large number of people extracting from a relatively small patch of forest. The discounted present value of net benefits for the three management approaches are summarized in Table 3-10. Therefore, using the criteria of positive net present value to judge worthiness of projects; FD and KWS management approaches fail the test from the local perspective while QCM passes the test.

The findings indicate that the forest adjacent people subsidize the conservation of Kakamega forest under FD and KWS by bearing the opportunity costs of its conservation. For the local people the forest land would be more profitable if it were converted to agricultural land for smallholder agriculture. This finding concur with those of (Kniivila *et al*, 2002; Kumar, 2002; Mburu and Birner, 2002; Norton-Griffiths, 1996) who found that opportunity costs exceeded the aggregate net benefits of forest conservation when viewed from the local people's perspective.

Table 3-10: Financial net present values by forest management approach: Local level

Management approach	Discounted Net Benefit (US $/ha) of Forest	
	Net benefit (opportunity Costs excluded)	Incremental net benefits (opportunity costs included)
FD	+ 375	-658
QCM	+ 3,408	+ 2,375
KWS	+ 128	-905

Source: **Own survey data, 2005/06**

Similarly, results of economic analysis indicates that from the national point of view FD and KWS management approaches are not economically worthwhile while QCM remain worthwhile as shown by results in Table 3-11 below.

Table 3-11: Economic net present values by forest management approach: National level

Management Approach	Discounted net benefit (US $/ha)	
	Net benefits (excluding the opportunity Costs)	Incremental net benefits (opportunity costs included)
FD	+ 1,300	- 226
QCM	+4,479	+ 3,180
KWS	+1,039	-261

Source: Authors survey, 2005/06

In general it can be concluded that the nation as a whole subsidizes the continued existence of the forest mainly due to perceived existence and/or option values. A study by Norton-Griffiths and Southey (1995) considered the overall costs of setting apart areas for nature conservation in Kenya and came to the same conclusion; the costs outweigh the benefits and therefore the country subsidizes conservation for the rest of the world. Otherwise, it could be argued that economic considerations are not the main guiding principles in conservation decisions for the case of Kakamega forest. However, the scenario changes when the global perspective is taken in conservation. As shown in Table 3-12, from a global point of view all the three management approaches are economically viable.

Table 3-12: Economic net present values by forest management approach: Global level

Management Approach	Discounted net benefit (US $/ha)	
	Net benefits (excluding the opportunity Costs)	Incremental net benefits (opportunity costs included)
FD	+ 1,447	+147
QCM	+ 4,271	+ 2,972
KWS	+ 1,433	+133

Source: Authors survey, 2005/06

From the local perspective, it is clear at the current level of utilization, the bulk of Kakamega forest, with the exception of QCM managed part cannot compete with the alternative use in smallholder farming given the assumptions made under the base scenario. This finding might partly explain the continuing deforestation and degradation of the forest over the years. The QCM managed part is able to remain profitable only at the expense of biodiversity conservation due to higher rates of degradation observed. It is also noteworthy that the difference in the NPV values for KWS and FD are not very high at the local and national level despite the differences in their approaches of management. The direct extraction benefits generated by the incentive-based management of FD is somewhat offset by the higher recreational benefits generated by protectionist approach of KWS due to better managed tourism enterprise. The finding that all the management approaches are profitable at the global level, potentially offers an opportunity for continued conservation of the forest especially if some sort of compensatory mechanism could be established.

3.6 Sensitivity Analysis

The sensitivity of CBA models were tested by running several possible scenarios by changing two important parameters of the models i.e. discount rates and benefit flows from the forest. Time horizon is held constant at 30 years because given the high discount rates chosen, future costs and benefits are negligible beyond the chosen time frame. As shown in Table 3-13 the results of sensitivity analysis for both financial and economic models do not change significantly when discount rate and are adjusted upward and downward by 50% of the base value. In essence changing the discount rates do not change the sign of the NPV´s of the three management approaches. It can therefore be argued that within a fairly good level of confidence of the chosen discount rates both financial and economic CBA models are stable given the assumptions made about trends of future flows of costs and benefits in the base scenario. As expected the NPV´s are smaller when the discount rates in high. The NPV for QCM remain positive at different discount rates and at all levels (local, national and global) due to the high levels of extraction that is taking place within its part of the forest. FD and KWS management approaches had negative NPV´s at the local and national levels but the NPV were positive at the global level. Its noteworthy that the NPV's of KWS

and FD management approaches were very similar despite the differences in their management styles. The protectionist approach of KWS is able to compensate what it denies the local people in direct extraction with higher indirect use values and earnings fron tourism. Sensitivity of the NPV's to future flows of benefits from the forest was tested by adjusting the rate of flow of benefits (using the rate of forest degradation/regeneration as a proxy) upward and downward by 50% of the rate assumed for the base scenario. The results show that the models are stable to significant changes in the flow of future benefits from the forest (see Table 3-14 below). The next Section provides the summary and conclusions of the chapter.

Table 3-13: Effect of changing discount rate on incremental net present values by forest management approach

Parameter	FD			QCM			KWS		
	Local	National	Global	Local	National	Global	Local	National	Global
150% of the base period	-434	-125	+133	+1,626	+2,201	+2,058	-615	-190	+80
Base period	**-658**	**-226**	**+147**	**+2, 375**	**+3,180**	**+2,972**	**-905**	**-261**	**+133**
50 % of the base period	-1,217	-504	+123	+4,121	+5,322	+4,973	-1,590	-414	+257

Source: Authors survey, 2005/06

Table 3-14: Effect of changing rate of flow of future benefits NPV's under different management approaches

Parameter	FD			QCM			KWS		
	Local	National	Global	Local	National	Global	Local	National	Global
150% of the base period	**-629**	**-234**	**+135**	**+2,342**	**+3,130**	**+2,924**	**-884**	**-267**	**+124**
Base period	**-658**	**-226**	**+147**	**+2, 375**	**+3,180**	**+2,972**	**-905**	**-261**	**+133**
50 % of the base period	**-687**	**-212**	**+164**	**+2,408**	**+3,231**	**+3,020**	**-925**	**-255**	**+140**

3.7 Chapter Summary and Conclusions

This Chapter focused on the costs and benefits of conserving and utilizing Kakamega forest and analyzed them under the framework of cost-benefit analysis. It has been argued in literature that degradation of forests has continued because their contribution to the society are not known or appreciated. This study closely followed the total economic value (TEV) approach in eliciting various types of benefits arising from Kakamega forest under the three different management approaches. These benefits as well as costs were valued from the perspective of different stakeholders from whom they accrue. The bulk of direct extractive benefits accrue to the local communities who also bear the opportunity cost of conservation. Other benefits such as watershed benefits accrue to the nation which also bears the management costs. Global benefits were identified as carbon sequestration and recreational benefits.

The study applied a number of valuation sources to generate these values. The direct extractive benefits were valued using the prevailing prices at the local markets while indirect use benefits were based on benefit transfers and other secondary sources. Extraction costs were valued at their opportunity costs for the local people while management costs were obtained from official records. Opportunity costs were obtained from secondary sources based on net returns from smallholder agriculture in the study area. Projection of future flows of costs and benefits was a critical part of the study. Given the uncertainty of the future, the study applied the most conservative projections to come up with the base scenario based on information about the future trends in forest degradation and supplemented by information about population growth rates, demand for forest products and such other information.

Results of the base scenario showed that the Forest generates an array of benefits to the local people but the opportunity costs overshadow these benefits except for the QCM managed part. However, it would be important to note that QCM part of the forest is the most disturbed among the three parts of the forest (Mitchell, 2004). This observation raises a question about how to meet the urgent extractive needs of the forest-adjacent people

without jeopardizing conservation goals. A similar pattern is observed at the national; the state-led approaches i.e. incentive based FD and protectionist based KWS both fail the test of worthwhile projects but the private incentive-based approach of QCM pass the test of an economically worthwhile project. But at the global level all the three management approaches are economically viable. The results of sensitivity analysis are stable to critical changes is discount rates and future flows of benefits from the forest. The results provide important lessons about how the future management of Kakamega forest can be made more economically profitable. For the continued existence of the forest the global community would have to share the cost burden that local communities currently bear on their behalf. Further discussion on the policy implications of the findings of this study are provided in Chapter 6 (Sub-Section 6.3).

4.0 LOCAL COMMUNITIES' SATISFACTION WITH FOREST MANAGEMENET APPROACHES

4.1 Introduction

This chapter focuses on the results of local community satisfaction levels with the three forest management approaches of Kakamega forest and the factors that influence them. Section 4.2 provides descriptive statistics of the results of community satisfaction ranking of different forest management approaches. Section 4.3 includes a discussion of regression results of the factors influencing different levels of satisfaction. Section 4.4 provides a discussion about the relative weights of different aspects of forest management in the overall satisfaction while Section 4.5 contains the summary and conclusions of the Chapter.

4.2 Satisfaction Levels with Different Forest Management Approaches

As noted earlier in Chapter 2 (Subsection 2.6.1) levels of satisfaction with the three forest management approaches were elicited by asking the respondents to score their overall satisfaction with the way the forest nearest to their residence is managed by assigning a satisfaction rank from among five different levels i.e. 1= very satisfied, 2=satisfied, 3=neutral, 4=dissatisfied and 5=very dissatisfied. The results of means and frequencies of satisfaction levels across the three management approaches are summarized in Table 4-1 below.

Table 4-1: Frequency and mean satisfaction levels under different forest management approaches

Management approach			% Frequency				
	Mean	SD	V. satisfied	Satisfied	Neutral	Dissatisfied	V. dissatisfied
FD	2.64	0.86	-	47.9	37.5	13.9	0.7
QCM	2.72	1.06	3.6	54.2	16.9	16.9	8.4
KWS	2.23	0.64	8.2	11.5	62.3	16.4	1.6

Source: Own Survey, 2005/06

In general, the satisfaction levels results showed that respondents were relatively more satisfied with the performance of the protectionist approach of KWS (mean 2.23) than the incentive-based approaches (2.64 and 2.72 for FD and QCM, respectively). Mean satisfaction levels for FD and QCM management approaches were more or less neutral. The difference of the means for the three levels was also tested. It was found that the satisfaction level with KWS approach was significantly higher than that of FD and QCM but the latter were not significantly different from each other.

The higher ranking of the protectionist approach may be attributed to the desire of the local communities to have the forest conserved for their future generations despite the pressing need to extract from the forest. Since taking over the management of one part of the forest 20 years ago, KWS has transformed what used to be a degraded forest into a regenerated one as shown by recent studies (Bleher *et al*, 2006; Lung and Schaab 2006). Among the three management approaches only KWS has recorded an overall increase in forest size through regeneration of formerly degraded areas and lowest rates of forest disturbance (Lung and Schaab 2006). The ranking of KWS performance as highest overall is not altogether surprising, some other studies have reported a good convergence between scientific and public view of forest health (see, for example, Patel *et al,* 1999 in a Canadian study). It should however be noted that although the local communities ranked FD and QCM approaches lower than that of KWS, they did not express strong dissatisfaction with their performance. This implies that the communities are willing to live with these management approaches most likely due to the benefits they derive from extraction of non-timber forest products.

Informal interviews conducted among key informants in the community largely mirror these findings; KWS is viewed as committed to conserving the forest by implementing its rules firmly and transparently as evidenced by strict protection against extraction and arrest of those who break the law. On the other hand FD and QCM are viewed as falling short of communities' expectations in implementing conservation rules firmly and equally despite allowing some level of regulated extraction from the forest. Therefore, the results of satisfaction ranking could also be interpreted as an expression of peoples' verdict on how

the forest management approaches apply and enforce their rules. Although not common, it is not surprising to find instances where people prefer protection-oriented state led conservation to community conservation. For instance, Obiri and Lawes (2001) found that among costal forest users of Eastern Cape in South Africa, protection-oriented state-led forest conservation was preferred over community-led conservation mainly due to weak local governance institutions. The next Section provides an analytical insight on factors that influenced respondent's levels of satisfaction under the three forest management approaches of Kakamega forest.

4.3 Determinants of Satisfaction Levels under Different Management Approaches

4.3.1 Analytical Procedures

In the analysis of levels of satisfaction with different forest management approaches, it was conceptualized that a respondent faced a choice between assigning his/her satisfaction level among five levels which represents underlying utilities U_1, U_2, U_2, U_4, and U_5 respectively, which are not observable. The observable variables are satisfaction levels (1=very satisfied, 2=satisfied, 3=neutral, 4=dissatisfied, 5=very dissatisfied) and a vector of respondents characteristics (*X*). The utility of respondent i, is formalized as follows:

$$U_{Yi} = V_{Yi} + \varepsilon_{Yi} \qquad (4\text{-}1)$$

Where U_{Yi} is the latent, unobserved utility corresponding to satisfaction level Y, V_{Yi} is the explainable part of the latent utility that corresponds to the chosen satisfaction level and a set of characteristics of respondent i, while ε_{Yi} is the random or 'unexplainable' component of the latent utility associated with the choice of satisfaction level Y. Respondent i's choice ordering between the five satisfaction levels of forest management indicators is modeled in the following way: respondent i ranks a management approach in one of the five satisfaction ranking levels based on the following indicator function:

$$Z_i = (V_{Y_a i} + \varepsilon_{Y_b i}) - (V_{Y_a i} + \varepsilon_{Y_b i}) = (\varepsilon_{Y_a i} - \varepsilon_{Y_b i}) - (V_{Y_a i} - V_{Y_b i}) \qquad Z>0 \text{ if } Y_a > Y_b \qquad (4\text{-}2)$$

Where Z_i is the additional utility/satisfaction derived by respondent i from a certain management approach which he/she assigns satisfaction level Y_a compared to a certain lower satisfaction/utility which he/she would rank as Y_b. The respondent expresses very

high dissatisfaction level (very poor) if Z_i is below some threshold value of U (say, μ_1), shows dissatisfaction (poor) if Z_i is above μ_1 but below another threshold value μ_2, expresses medium level of satisfaction (neutral) if Z_i is above μ_2 but below another threshold value μ_3 and expresses high level of satisfaction (good) if Z_i is above μ_3 but below another threshold μ_4, expresses very high satisfaction (very good) if Z_i is above μ_4.

Formally, respondent's i's choice ordering (denoted by Y_i where Y = 1 implies very good, Y = 2 implies good, Y = 3 implies neutral, Y=4 implies poor and Y=5 implies very poor) can be expressed as follows:

$$
\begin{aligned}
&Y_i = 1 \text{ if } Z_i > \mu_4 \\
&Y_i = 2 \text{ if } \mu_3 < Z_i < \mu_4 \\
&Y_i = 3 \text{ if } \mu_2 < Z_i < \mu_3 \\
&Y_i = 4 \text{ if } \mu_1 < Z_i < \mu_2 \\
&Y_i = 5 \text{ if } Z_i < \mu_1
\end{aligned}
\qquad (4\text{-}3)
$$

Since part of the utility is random in nature, a researcher cannot perfectly predict the choice of an individual. From the researchers' perspective, the problem is inherently stochastic, which naturally leads to formulating the i^{th} individual's choice problem in probability terms:

$$
\begin{aligned}
&P(Y_i = 1 \mid \text{Choice Set}) = P[Z_i = (\varepsilon_{ji} - \varepsilon_{ki}) - (V_{ji} - V_{ki}) > \mu_4) \\
&P(Y_i = 2 \mid \text{Choice Set}) = P[\mu_3 < Z_i = (\varepsilon_{ji} - \varepsilon_{ki}) - (V_{ji} - V_{ki}) < \mu_4) \\
&P(Y_i = 3 \mid \text{Choice Set}) = P[\mu_2 < Z_i = (\varepsilon_{ji} - \varepsilon_{ki}) - (V_{ji} - V_{ki}) < \mu_3) \\
&P(Y_i = 4 \mid \text{Choice Set}) = P[\mu_2 < Z_i = (\varepsilon_{ji} - \varepsilon_{ki}) - (V_{ji} - V_{ki}) < \mu_3) \\
&P(Y_i = 5 \mid \text{Choice Set}) = P[Z_i = (\varepsilon_{ji} - \varepsilon_{ki}) - (V_{ji} - V_{ki}) < \mu_1)
\end{aligned}
\qquad (4\text{-}4)
$$

Under the assumption that the random term $(\varepsilon_{ji} - \varepsilon_{ki})$ follows standard normal distribution the above probabilistic model is an ordered-probit model (Greene, 2003).

In empirical estimation, the indicator Z_i for the respondent i is modeled as a function of his/her socioeconomic and other relevant attributes and can be expressed as:

$$Z_i = \beta' X + V_i = \beta_o + \beta_1 x_{i1} + \beta_2 x_{i2} ... \beta_k x_{ik} + v_i \quad \text{i =1, 2,…,n} \qquad (4\text{-}5)$$

where: x_{ij} = j^{th} attribute of the i^{th} individual; $\beta = (\beta_0, \beta_1, \ldots, \beta_k)$ = the parameter vector to be estimated; and ν = random error or disturbance term. At the empirical estimation stage, both the β-vector and the μ's are estimated jointly using the maximum likelihood estimation (MLE) procedure. The estimated β-coefficients of equation (4-5) do not necessarily represent the marginal effects of the independent variables on the probabilities of choice (Greene, 2003). This is because ordered probit is a non-linear regression model and therefore, the β-coefficients are not the marginal effects in ordinary linear models. This makes the marginal effects very important to evaluate the effects of a marginal change in the independent variables on the dependent variable. The marginal effects are given by the following expression (assuming continuous explanatory variables):

$$\frac{\delta P(Y_i = 1)}{\delta X_j} = \phi(\mu_1 - \beta' X)\beta_j$$

$$\frac{\delta P(Y_i = 2)}{\delta X_j} = \phi(\mu_1 - \beta' X)\beta_j - \phi(\mu_2 - \beta' X)\beta_j$$

$$\frac{\delta P(Y_i = 3)}{\delta X_j} = \phi(\mu_2 - \beta' X)\beta_j - \phi(\mu_3 - \beta' X)\beta_j \qquad (4\text{-}6)$$

$$\frac{\delta P(Y_i = 4)}{\delta X_j} = \phi(\mu_3 - \beta' X)\beta_j - \phi(\mu_4 - \beta' X)\beta_j$$

$$\frac{\delta P(Y_i = 5)}{\delta X_j} = \phi(\mu_4 - \beta' X)\beta_j$$

where $\emptyset$ is the density function of standard normal variable. In the case where the explanatory variable is discrete or categorical in nature, the marginal effect of such a variable is obtained by evaluating the probabilities at alternative values of x_{ij} (Greene, 2003). For example, the marginal effects for the dummy variables are calculated as the difference between two resulting probabilities when the dummy variable equals its two values 0 and 1.

4.3.2 Empirical Estimation and Hypotheses

Table 4-2 summarizes the factors (x_i's) that were postulated to influence satisfaction levels of the respondents.

Land size (LAND_SZ) and number of livestock units (LVST_UNIT) were included in the models as proxies for a household's durable assets and disposable resource endowments respectively. There is evidence in literature which suggests that a household's wealth status influences attitudes towards conservation (Lise, 2000). Since farming is the main economic activity in the study area, it was anticipated that households with larger pieces of land and more livestock are more likely to be wealthier than those with smaller pieces of land and fewer livestock. It is plausible to assume that the wealthier the households, the less likely they will rely on forest for their livelihoods because they can easily access the more expensive alternatives. For example wealthier households can afford to use cooking gas or paraffin hence they do not need to collect firewood from the forest. Hence they are likely to be more satisfied with the protectionist management approach.

It is expected that people living closer to forest would have more interaction with forest management than those further away. It is plausible to postulate that distance from the forest edge (FRST_DIST) is likely to influence the respondents' satisfaction level since households living closer to the forest suffer more from human-wildlife conflicts than those further away. Such households are therefore likely to be dissatisfied with forest management authorities that do not protect them from such attacks. Some studies have found that people living further away from the forest had more positive attitudes towards conservation, mainly because they did not suffer crop damage by wild animals (Shrestha and Alavalapati, 2006). On the other hand, people living closer to forests can more easily access forest products that those further away. Therefore, if people living closer to forest and are allowed to extract they are could to express a higher level of satisfaction than those further away especially if they do not suffer attacks by wild animals.

Table 4-2: Factors postulated to influence satisfaction levels

Factors	Description	FD		QCM		KWS	
		Mean	SD	Mean	SD	Mean	SD
FRST_DIST	Distance in km of the household homestead from the nearest forest edge	3.80	3.70	0.91	0.88	3.93	3.05
MRKT-DIST	Distance in Km from the household to the nearest market center	2.69	3.04	1.09	1.29	2.74	3.25
NTFP_YES	If a household collected NTFP's from the forest in the last one year (If yes=1 otherwise=0)	0.24	0.43	0.24	0.43	0.13	0.34
FRS_ACTV	Involvement in forest conservation activity one year preceding the study (if yes=1, otherwise=0)	0.11	0.31	0.17	0.38	0.33	0.48
HHH_SEX	Gender of the household head (1 if male 0 if female)	0.79	0.40	0.72	0.45	0.85	0.35
EDUC_HH	Years of formal education of the household head	7.61	3.56	8.64	4.29	7.73	3.45
HH_SIZE	Number of resident household members	5.49	2.01	5.43	2.38	5.12	1.92
SGRP_MEM	Number of social group memberships	0.72	0.56	0.28	0.53	0.67	0.57
LVST_UNIT	Livestock units owned by a household	3.14	1.28	2.29	1.61	3.36	1.37
LAND_SZ	Total land holding in hectares	1.00	0.62	0.65	0.74	1.66	1.11

Source: Own Survey 2005/2006

Respondents with high levels of formal education (EDUC_HH) are expected to have more understanding on the importance of conservation hence better evaluative judgment, but it would be difficult to determine *a priori* the direction of influence that level of education would have under the three different management approaches. Education has been shown to result in positive attitudes towards conservation in a number of studies for example; Lise, (2000) and Shrestha and Alavalapati, (2006). In essence, respondents with higher levels of education are likely to have better access to off-farm income than those with less

or no formal education hence are less likely to be dependent on the forest for livelihood. In the case where education increases the 'wealth status' of an individual, respondents with higher levels of education would be in favor of a protectionist approach to forest management. On the other hand, higher levels of education could lead to an individual to have higher expectations of the performance of the forest management hence it would be difficult to determine a priori how an individuals' level of education would influence his/her judgment of a given forest management approach.

Proximity to market centers (MRKT-DIST) was included in the model as a proxy for a household's level of integration with non-farm activities. Although it was not possible to predict beforehand the direction of its influence on satisfaction level, it is plausible to assume that increased integration with non-farm activities might have a positive influence on the respondent's relationship with forest conservation authorities since pressure on forest resources is reduced (Thacher *et al,* 1997). Communities extracting products from the forest are postulated to have a more favorable view of forest management approaches that allow extraction. Several studies have found a positive association between forest dependency and positive perception towards conservation (McFarlane and Boxall 2000; Racevskis and Lupi, 2006). Therefore, forest extraction (NTFP_YES) is postulated to increase satisfaction with FD and QCM management approaches since they both allow extraction.

Individuals involved in any forest conservation activities (FRS_ACTV) are likely to have a positive judgment towards conservation and therefore their satisfaction with the forest management approaches would be considerably high. This is because participation in conservation activities is voluntary and therefore only individuals with interest in conservation of the forest would participate. Many studies have attempted to examine the relationship between gender and perception of ecological problems and attitudes toward environmental conservation. Differences in environmental conservation perception between men and women have been noted in several studies (Dougherty *et al*, 2003; Anthony *et al*, 2004; Lise 2000; Hill, 1998). Some studies have found a higher concern for the environment among women compared to men (McFarlane and Boxall, 2000; Anthony

et al, 2004). As noted by Dougherty *et al,* (2003), gender is used as an explanatory variable because it can sometimes be strongly correlated with values. Several authors have criticized use of gender as a surrogate for values arguing that mean differences between individuals with different value orientation are often greater than differences between genders (Kalof *et al,* 2002; Zinn and Pearce, 2002). The communities living in Kakamega, like in many areas all over Africa, exhibit many differences between genders in many facets of life e.g. decision-making at the household levels, access to resources, levels of education and such others therefore, it is a point of interest to check whether gender differences exist with satisfaction with forest management. In this study, gender of the household head (HH_SEX) was included in the regression but for the particular case of Kakamega forest, it was not possible to predict *a priori* how gender would influence satisfaction.

The role of local groups and associations in bringing about positive conservation outcomes has been noted in literature (Pretty and Ward, 2001). Membership to such groups and the associated values of social relations, in the form of trust, reciprocal arrangement and locally developed rules, norms and sanctions are important ingredients in shaping individuals action and hence are important in influencing outcomes of biodiversity conservation. Before the emergence of the current formal institutions of management, local communities have been engaging in different forms of collective action in managing natural resources institutionalized in form of clan, kin groups, traditional leadership and labor-exchange societies. Membership to social groups (SGRP_MEM) was hypothesized to influence satisfaction towards forest management in the positive direction but it is not clear how it would influence satisfaction with different management approaches.

It was postulated that since large households require more resources, the size of the household (HH_SIZE) is likely to positively influence satisfaction with the incentive based approaches of FD and QCM. Some studies have found that larger households especially those with many children, are more dependent on forest for their livelihoods mainly due to low opportunity costs of children's time (Ejigie, 2005). However, as noted by Shrestha and Alavalapati (2006), HH_SIZE might lead to positive attitudes towards more protectionist approach if economic opportunities increase with family size.

4.3.3 Results and Discussion

Three ordered probit regressions were estimated one for each of the three management approaches. The results for FD, QCM and KWS management approaches are summarized in Tables 4-3, 4-4 and 4-5 respectively. In all the three models, the chi-square values for the log-likelihood functions were significant indicating that all coefficients of the included independent variables were significantly different from zero. The goodness of fit of an ordered probit regression is measured by the McFadden/pseudo R^2 which is analogous to R^2 in conventional regression. A zero value of pseudo R^2 indicates lack of fit while value of one indicates perfect fit. However, it is important to note that measure of fit for pseudo R^2 is not chosen so as to maximize the fitting criterion of dependent variable as it is in the classical OLS regression but rather the joint density of the observed dependent variables (Greene, 2003). Empirical evidence suggests that it is generally acceptable to have values of pseudo R^2 between 0.2 and 0.4 (Pindyck and Rubinfeld 1981; Mbata, 1997). The values of the pseudo R^2 for the three models were; 0.26, 0.23 and 0.31 for FD, QCM and KWS respectively and therefore, the models could be regarded as having a fairly good fit of the data. The results of the regression are discussed in the subsequent paragraphs.

Table 4-3: Factors determining satisfaction level for FD management approach

Factor	Satisfied	Neutral	Dissatisfied	V. dissatisfied
	dy/dx	dy/dx	dy/dx	dy/dx
FRST_DIST	0.0062	0.1418	-0.0634	-0.0807
	(0.0089)	(0.1338)	(0.0644)	(0.0772)
MRKT-DIST	-0.0014	-0.0317***	0.0142*	0.0180**
	(0.0018)	(0.0124)	(0.0079)	(0.0081)
NTFP_YES	0.0164	0.2203	-0.1121	-0.1214
	(0.0243)	(0.1643)	(0.1033)	(0.0862)
FRS_ACTV	0.0032	0.0614	-0.0293	-0.0339
	(0.0105)	(0.1617)	(0.0832)	(0.0861)
HHH_SEX	-0.0015	-0.0332	0.0152	0.0187
	(0.0080)	(0.1585)	(0.0740)	(0.0887)
EDUC_HH	-0.0018	-0.0420*	0.0188	0.0239*
	(0.0025)	(0.0231)	(0.0128)	(0.0142)
HH_SIZE	-0.0024	-0.0552	0.0248	0.0314
	(0.0033)	(0.0385)	(0.0196)	(0.0230)
SGRP_MEM	-0.0124	-0.2818*	0.1265	0.1603
	(0.0169)	(0.1729)	(0.0874)	(0.1109)
LVST_UNIT	0.0006	0.0107	-0.0048	-0.0061
	(0.0027)	(0.0591)	(0.0264)	(0.0338)
LAND_SZ	-0.0066	-0.1493	0.0670	0.0850
	(0.0089)	(0.0943)	(0.0477)	(0.0590)
Log-Likelihood	-41.16			
Pseudo R^2	0.26			
LR Chi-square	29.53***			

*** (significant at 1%), ** (significant at 5%) and * (significant at 10%)

NB: Figures in parentheses are the standard errors

Source: Own survey data, 2007

It should also be noted that marginal effects were computed for only 4 levels out of the 5 levels for each model due to either very few respondents or none at all assigning certain satisfaction levels to the management approaches. For example, as shown in Table 4-3, there were no respondents who ranked their satisfaction with FD as very satisfied.

Table 4-4: Factors determining satisfaction level for QCM management approach

Factor	Satisfied	Neutral	Dissatisfied	V. disatisfied
	dy/dx	dy/dx	dy/dx	dy/dx
FRST_DIST	0.0065	0.1309	-0.0635	-0.0674
	(0.0091)	(0.1305)	(0.0666)	(0.0677)
MRKT-DIST	-0.0014	-0.0278***	0.0135**	0.0143**
	(0.0017)	(0.0114)	(0.0073)	(0.0068)
NTFP_YES	0.0145	0.1876	-0.1024	-0.0919
	(0.0221)	(0.1668)	(0.1073)	(0.0770)
FRS_ACTV	0.0080	0.1137	-0.0615	-0.0555
	(0.0158)	(0.1448)	(0.0887)	(0.0674)
HHH_SEX	-0.0054	-0.0913	0.0469	0.0459
	(0.0109)	(0.0314)	(0.0758)	(0.0701)
EDUC_HH	-0.0019	-0.0386*	0.0187	0.0199*
	(0.0025)	(0.0218)	(0.0125)	(0.0120)
HH_SIZE	-0.0009	-0.0191	0.0093	0.0099
	(0.0019)	(0.0314)	(0.0156)	(0.0164)
SGRP_MEM	-0.0059	-0.1189	0.0576	0.0612
	(0.0092)	(0.1272)	(0.0637)	(0.0686)
LVST_UNIT	-0.0004	-0.0083	0.0040	0.0043
	(0.0029)	(0.0569)	(0.0277)	(0.0292)
LAND_SZ	-0.0081	-0.1632*	0.0793*	0.0840
	(0.0103)	(0.0902)	(0.0495)	(0.0531)
Log-Likelihood	-46.25			
Pseudo R^2	0.23			
LR Chi-square	27.23***			

*** (significant at 1%), ** (significant at 5%) and * (significant at 10%)

NB: Figures in parentheses are the standard errors
Source: Own survey data, 2007

Generally, the results of the ordered probit regression showed that in each model, only three factors of the ten included were significant in explaining satisfaction levels. Under incentive based management approaches of FD and QCM, increasing distance from the market centers had a positive and significant influence on the probability that a respondent would be dissatisfied or very dissatisfied (see Tables 4-3 and 4-4). This implies that the further away the respondents were from market centers the more likely they were to

express dissatisfaction with incentive-based forest management approaches. As noted in introduction Chapter (Section 1.7) there were significant differences in distance to market centers between respondents in the different management approaches. On average respondents under QCM management were closest to markets while those under KWS were furthest. Based on the assumption that respondents further away from market centers are likely to have less off-farm income earning opportunities especially in commerce, they are likely to be more dependent on the forest. From the foregoing argument it is somewhat surprising that people who are likely more dependent on the forest tend to be more disappointed with the incentive-based approaches of forest management. However, this is not necessarily unexpected given the fact that overall respondent were more satisfied with the protectionist approach. Furthermore, households that are more dependent on the forest are likely to have more interactions with forest management hence likely to form negative opinion compared to those with limited interaction. The finding of this study concurs with that of Shrestha and Alavalapati (2006) who found a more negative attitude toward conservation among households who are more dependent on the forest because of restriction the management place on extraction as well as unfairness in application of rules.

Education had a similar effect on overall satisfaction in the incentive based management approaches of FD and QCM. Higher levels of education increased the probability of a respondent being very dissatisfied while decreasing the probability of being neutral. This finding somewhat fits with prior expectation that high level of education would enhance positive attitudes towards more strict conservation or negative attitude toward less protective approach. Membership to social groups increased the probability of a respondent being neutral with the incentive-based approach of FD without any significant effect on satisfaction or dissatisfaction. Therefore it can be argued that membership to social groups did not have a lot of influence on satisfaction level. Respondents with larger pieces of land had a higher probability of being neutral or dissatisfied with incentive-based approach of QCM. This finding fits well with our priori expectation that land being a proxy for wealth, would influence the respondents' to favor more strict conservation.

Table 4-5: Factors determining satisfaction level for KWS management approach

Factor	V. Satisfied	Satisfied	Neutral	Disatisfied
	dy/dx	dy/dx	dy/dx	dy/dx
FRST_DIST	-0.0016	-0.0270*	0.0211	0.0067
	(0.0026)	(0.0156)	(0.0158)	(0.0065)
MRKT-DIST	0.0043	-0.0701**	-0.546	-0.0175
	(0.0067)	(0.0328)	(0.0357)	(0.0165)
FRS_ACTV	-0.0038	-0.0634	0.0445	0.0199
	(0.0014)	(0.0567)	(0.0445)	(0.0256)
HHH_SEX	-0.0553	-0.2970	0.3305	0.0196
	(0.0757)	(0.1916)	(0.2392)	(0.0209)
EDUC_HH	0.0021	-0.0348**	-0.0271	-0.0087
	(0.0034)	(0.0175)	(0.0188)	(0.0081)
HH_SIZE	-0.0006	-0.0098	0.0077	0.0025
	(0.0014)	(0.0186)	(0.0149)	(0.0051)
SGRP_MEM	-0.0010	-0.0168	0.0131	0.0042
	(0.0037)	(0.0336)	(0.0443)	(0.0145)
LVST_UNIT	0.0017	-0.0272	-0.0212	-0.0068
	(0.0034)	(0.0352)	(0.0297)	(0.0102)
LAND_SZ	0.0009	-0.0150	-0.0117	-0.0037
	(0.0015)	(0.0107)	(0.0100)	(0.0039)
Log-Likelihood	-27.41			
Pseudo R^2	0.31			
LR Chi-square	24.88***			

*** (significant at 1%), ** (significant at 5%) and * (significant at 10%)

NB: Figures in parentheses are the standard errors

Source: Own survey data, 2007

Under the protectionist approach of KWS, increasing distance from the forest edge decreased the probability of a respondent being satisfied with the approach (see Table 4-5) though somewhat surprising, it could be argued that since respondent who were further away from the forest are likely to have less interaction with the forest management, they lack first hand information about its performance. Similarly, increasing distance from market centers and increasing education both decreased the probability that a respondent would be satisfied with the protectionist approach. The effect of education on satisfaction with protectionist approach of KWS was not expected but not surprising. Although the

protectionist approach has successfully managed the forest, it has done so without involving the participation of the local communities. It could also be argued that the more educated respondents might be dissatisfied with the processes of achieving the goal of conservation without necessarily being dissatisfied with its achievement.

4.4 Relative Importance of Different Aspects of Forest Management

4.4.1 Analytical Procedures

The procedure applied for analyzing the relative weights of different management attributes in the overall satisfaction is an adaptation of the conventional conjoint analysis. The conceptual foundation of conjoint analysis is based on consumer theory laid out by Lancaster (1966) which proposes that utility is derived from characteristics of goods or services rather than the goods/services themselves *per se*. A major implication of this theory is that the overall consumer utility for a good or service can be decomposed into separate utilities of its constituent characteristics or benefits (Hair *et al*, 1998; Green and Srinivasan, 1978, Sy *et al*, 1997; Dennis, 1998; Zinkhan *et al*, 1997). Conjoint analysis is a technique that is applied for establishing the relative importance of different attributes in the provision of a good or service from the perspective of the consumer (Sy *et al*, 1997; Van der Pol and Mandy, 1996). In practice, the respondent is asked to rank, score or order a set of 'hypothetical' characteristics of the product or service in question. The situation being considered is presented to respondents hypothetically as verbal descriptions, paragraph descriptions or pictorial representations (Green and Srinivasan, 1978). Verbal descriptions use cards in which each level of attribute under consideration is described in a brief line item fashion, while paragraph descriptions give a more detailed description of each level. Pictorial representations use some graphical images to present the levels of attributes. In practice, the respondent is asked to rank, score or order a set of characteristics of the product or service in question. From these rankings or scores, conjoint analysis derives utility weights for each product/service attribute level using regression analysis. Utility scores are analogous to regression coefficients and are also known as part worth and are indicative of the weight of each characteristic in the overall performance of a product or service (Green and Srinivasan, 1978). Several studies have applied conjoint analysis in the context of forest management; for example Zinkhan *et al* (1997) and Dennis (1998), both

applied conjoint analysis to analyse public preference of forest management in the context of forests with multiple benefits the in USA.

In this study, unlike in conventional conjoint analysis, where the respondents are asked to rank attributes based on descriptions provided by the researchers, satisfaction ranking with forest management was obtained based on their real-life experiences based on their day-to-day interactions with the forest management. In this respect therefore, the study deviates from the conventional conjoint analysis. There are two advantages of this approach; first, it is more practical because respondents provide their ranking based on real life experience unlike in conventional conjoint studies that are based on hypothetical scenarios. Secondly, it made it possible to estimate the weights of different forest management aspects that are rather diffuse and cannot be easily described in the conventional pictorial, verbal or descriptive manner. To capture the satisfaction levels of the respondents, pictorial presentation of locally used water storage containers with five different water levels (from full, to empty) were used to represent varying levels of satisfaction/dissatisfaction i.e. from 1 = very satisfied, 2 = satisfied, 3 = neutral, 4 = dissatisfied, 5 = very dissatisfied (see Appendix 1). The overall satisfaction rank is regressed against the satisfaction ranking of different forest management attribute in a manner similar to conventional conjoint analysis.

Parameter estimation methods in conjoint analysis depend on the nature of dependent variable. For interval scaled dependent variables e.g. scores, the ordinary least squares (OLS) regression is appropriate, but for ordered dependent variables like rank, ordered probit or logit is ideal (Greene, 2003). In this study, an ordered probit was applied because the dependent variable i.e. satisfaction level, was generated as an ordered ranking. Once estimation process is completed, relative importance of a given attribute is calculated using the following formulae:

$$\psi_i = [Max(U_{ji}) - Min(U_{ji})] \Big/ \sum \omega_i \qquad (4\text{-}7)$$

Where ψ_i is the 'part worth'/ relative weight of the i-th attribute, U_{ji} is the marginal value of j-th level of the i-th attribute; $\sum \omega_i$ is the sum of the ranges i.e. [Max (U_{ji}) – Min (U_{ji})]

across all the attributes. To estimate the relative weights of the different forest management attributes, an ordered probit regression was estimated for each of the management approach to determine which of management aspects were significant in explaining the overall satisfaction. Once the significant attributes were identified, their marginal effects at different levels of satisfaction were computed. Finally, from the results of analysis of marginal effects of significant management aspects, relative weight of each of them was calculated using equation 4-7 and the empirical estimation and results of the analysis are presented and discussed in the subsequent Section.

4.4.2 Empirical Estimation

Table 4-6 defines the 16 different aspects of forest management aspects that were considered in this study.

Table 4-6: Definition of forest management aspects considered

Management aspect	Definition
EXT_RULE	People's involvement in making extraction rules
CONS_DEC	People's involvement in decision to preserve pristine parts of the forest
GEN_CONF	Resolution of general conflicts
WILD_CONF	Resolution of wildlife-human conflicts
SCHL_OUT	Promotion of school outreach programs
ENV_ACT	Promotion of environmental improvement activities
ALT_ENG	Promotion of alternative energy sources
TREE_SEED	Provision of tree seedlings
ALTINC_ACT	Promotion of alternative income activities
CLA_RULE	Clarity of enforcement rules
STR_RULE	Straightforwardness of the extraction rules
ENF_RULE	Enforcement of rules
LEV_EXTR	Level of forest extraction allowed
EMP_LOC	Provision of employment to local people
PREV_CDMG	Prevention of crop damage by wildlife
COMP_CDMG	Compensation for crop/livestock loss

Source: Own survey 2005/2006

The mean satisfaction ranking levels of these aspects are summarized in Table 4-7. The results of mean satisfaction ranking for different management services reveal that across the management approaches, the respondents are unsatisfied with the handling of human-

wildlife conflicts, efforts to promote energy saving technologies, prevention of crop damage by wild animals and provision of employment opportunities for locals. It is important to note that the there is a clear discrepancy between mean overall satisfaction as elicited from the respondent and the average satisfaction calculated as a simple average of the satisfaction ranking of all aspects of management. This means that the respondents did not attach the same weight to all the aspects of forest management (see Section 2.6 for theoretical arguments). The results of conjoint analysis presented in the next section, shed more light on the relative importance of the different aspects of forest management across management approaches in the overall satisfaction.

Table 4-7: Mean satisfaction levels of forest management aspects by management approaches

	FD		QCM		KWS	
Variable	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
OVERALL_SAT	2.64	0.86	2.72	1.06	2.23	0.64
Average_SAT	3.85	0.51	3.75	0.48	3.43	0.41
EXT_RULE	3.41	0.93	4.46	0.65	4.78	0.42
CONS_DEC	2.89	1.20	2.39	1.16	2.17	1.04
GEN_CONF	3.88	0.76	3.77	0.79	3.68	0.72
WILD_CONF	4.12	0.73	3.85	0.74	4.10	0.71
SCHL_OUT	3.54	1.04	3.70	0.94	2.97	1.05
ENV_ACT	3.57	1.00	3.58	0.93	3.39	0.69
ALT_ENG	4.25	0.76	4.11	0.84	3.91	0.64
TREE_SEED	3.82	0.93	3.70	1.00	3.78	0.70
ALTINC_ACT	4.36	0.60	4.19	0.84	4.17	0.57
CLA_RULE	3.44	2.97	3.40	0.99	2.31	1.16
STR_RULE	2.49	0.90	3.60	0.99	2.45	0.90
ENF_RULE	2.12	0.94	3.35	0.94	2.12	0.94
LEV_EXTR	3.54	1.01	3.59	0.91	3.19	0.93
EMP_LOC	4.45	0.67	4.11	0.88	4.58	0.55
PREV_CDMG	4.58	0.60	4.46	0.65	2.69	0.99
COMP_CDMG	4.88	033	4.34	0.61	4.88	0.33

Source: Own survey 2005/2006

Analysis began by estimating an ordered probit regression for each of the management approach to determine which of the 16 management aspects were significant in explaining the overall satisfaction. However, strong co-linearity between the dependent variables (i.e.

forest management aspects) would result in biased estimated coefficients of the ordered probit regression. To check for co-linearity, Spearman rank correlations were run for all the three management approaches to inspect the level of correlation among the included variables. The correlation tables for FD, QCM and KWS are presented in appendices 2A, 2B and 2C respectively. As noted by Kennedy (1985) a value of 0.8 or higher in one of the correlation coefficients indicates a high correlation between the two independent variables to which it refers. Based on this criterion, three aspects were dropped from the regression; enforcement of rules, compensation for crop/livestock damage and straightforwardness of extraction rules. But the closely related aspects such as participation in making extraction rules, clarity of enforcement rules and prevention of crop/livestock damage were retained.

In the second stage, the marginal effects of the management aspects that were significant for each management approach were computed. This is because as noted earlier the coefficients of ordered probit regressions do not necessarily show the marginal effects of the independent variables (Greene, 2003). Finally, from the results of analysis of marginal effects of the significant management aspects, relative weights or 'part worth' of each of them was calculated using equation 4.7 and the results of the analysis are presented and discussed in Sub-section 4.4.3.

4.4.3 Results and Discussion

Results of ordered probit regression on the levels of overall satisfaction against specific management aspects for the three management approaches are summarized in Table 4-8. The three models had significantly high values of log-likelihood chi-square suggesting that all the coefficients of independent variables were significantly different from zero for each of the model. The values of the pseudo R^2 for the three models were; 0.16, 0.22 and 0.19 for FD, QCM and KWS respectively and therefore, the models could be regarded as having a fairly good fit of the data (see Pindyck and Rubinfeld, 1981).

Table 4-8: Ordered probit regression results for different aspects of forest management

Variables	FD		QCM		KWS	
	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
EXT_RULE	0.1047	0.1927	0 .7460***	0.2193	0.2216	0.2997
CONS_DEC	0.1502	0.1192	-0.4496***	0.1404	0.6873***	0.2675
GEN_CONF	0.0428	0.1928	-0.0491	0.2752	-0.4268	0.3628
WILD_CONF	0.3192	0.1990	0.7106***	0.2976	0.5002	0.4125
SCHL_OUT	0.2023	0.1752	-0.3994	0.3024	0.1791	0.2658
ENV_ACT	-0.0933	0.1779	-0.2145	0.3078	0.1435	0.2658
ALT_ENG	-0.0182	0.1802	-0.2156	0.2728	-0.0924	0.3585
TREE_SEED	0.1116	0.1676	0.0568	0.1993	0.4109	0.3356
ALTINC_ACT	-0.0767	0.2276	0.1179	0.3007	-0.5287	0.3713
CLA_RULE	0.2883	0.1643	0.1683	0.1927	0.0831	0.3264
LEV_EXTR	0.1560*	0.1698	0.0074	0.2212	-0.2277	0.2765
EMP_LOC	0.1926	0.2544	0.1656	0.2230	1.2355**	0.5608
PREV_CDMG	-0.8191***	0.2824	0.4435	0.2948	-0.8056	0.6949
Log-likelihood	-133.87			-74.65		-47.73
LR Chi Sq.	51.22***			42.61***		23.02**
Pseudo R^2	0.16			0.22		0.19

*denotes significance at 10% level, **at 5% level, and *** at 1 % level

Source: Own survey data, 2007

Under the state-led incentive based management approach of FD, two aspects of forest management were found to be significant in explaining variation in overall satisfaction; level of forest extraction allowed and prevention of crop damage by wild animals. Under the private incentive based approach of QCM, three management aspects had significant influence on the overall satisfaction; community participation in making extraction rules, decision to preserve pristine parts of the forest for conservation and resolution of human-wildlife conflicts. In state-led protectionist approach of KWS, two aspects of management were significant in influencing the overall satisfaction ranking; community involvement in decision to preserve unique parts of the forest and provision of employment opportunities for the local people. The results of marginal analysis are summarized in Table 4-9 followed by a further discussion about the significant aspects of forest management.

Table 4-9: Marginal effects of different forest management aspects under the three management approaches

Management aspects	Marginal effects				
			FD		
	V. satisfied	Satisfied	Neutral	Dissatisfied	V. dissatisfied
LEV_EXTR	-0.0088	-0.1060*	0.0703*	0.043*	0.0011
PREV_CDMG	0.0251	0.3012***	-0.1996***	-0.1237***	-0.0030
			QCM		
EXT_RULE	0.0207	-0.2648***	0.1222**	0.1309***	0.0325*
CONS_DEC	0.0125	0.1597***	-0.0736**	-0.0789***	-0.0195*
WILD_CONF	-0.0197	-0.2523**	0.1164*	0.1247**	0.0309
			KWS		
CONS_DEC	-0.0134	-0.1085**	-0.0241	0.1388***	0.0073
EMP_LOC	-0.0242	-0.1950*	0.0433	0.2495**	0.0131
	*denotes significance at 10% level, **at 5% level, and *** at 1 % level				

Source: Own survey data, 2007

Two aspects of forest management were found to be significant in explaining variation in overall satisfaction under the incentive-based management of FD; the level of forest extraction allowed and prevention of crop damage by wild animals. Results of analysis for relative weights showed that prevention of crop damage and forest extraction allowed accounted for about 71% and 29% of the variation in overall satisfaction respectively (Table 4-10). Marginal analysis of the ordered probit showed that the level of forest extraction that is currently allowed negatively influenced satisfaction while the efforts to prevent crop damage by wild animals, increased the probability of respondents being satisfied in the FD management. The finding that forest extraction had a negative influence on the overall satisfaction, although somewhat surprising could be explained by the prevalent perception among local people who view FD as lacking in transparency and accountability. Informal interviews indicated that the main contention with extraction allowed relates to partial and unfair implementation of extraction rules and the associated forest degradation. In general, several studies in literature have found positive attitudes towards conservation where individuals obtain direct economic benefits (Gadd, 2005; Walpole and Goodwin, 2001), but unfavorable attitudes are prevalent where there is lack of

transparency and accountability in implementation of rules even if extraction is allowed (Mehta and Kellert, 1998). This finding seem to point out that in conservation offering communities benefit alone is not enough it has to be accompanied with fairness in distribution and transparency.

Table 4-10: Relative weights of different management aspects

	FD		QCM		KWS	
Forest management aspects	Partworth	%	Partworth	%	Partworth	%
LEV_EXTR	0.1763	70.68				
PREV_CDMG	0.4249	29.32				
WILD_CONF			0.3770	37.28		
EXT_RULE			0.3957	39.13		
CONS_DEC			0.2386	23.59	0.2473	35.75
EMP_LOC					0.4445	64.25
Total		100		100		100

Source: Own survey data, 2007

Intuitively, crop damage by wild animals from the forest is likely to lead to dissatisfaction with forest management but there have been cases where the economic benefits of extraction overshadow its negative influence (see Sekhar, 1998 for an example in India). In the case of Kakamega forest, crop damage is limited to farm bordering the forest; hence respondents who do not suffer any crop damage might tend to attribute it to the forest management efforts though it is not necessarily the case.

Under the private incentive based approach of QCM, three management aspects had significant influence on the overall satisfaction; community participation in making extraction rules, decision to preserve pristine parts of the forest for conservation and resolution of human-wildlife conflicts. Results of analysis for relative weights showed that resolution of wildlife-human conflicts accounted for about 24% of the total variation in overall satisfaction. Public participation in making extraction rules and public participation in the conservation activities accounted for 37% and 39% of the variation in overall satisfaction respectively. The results of marginal analysis in Table 4-9 showed that the current levels of public involvement in making rules of forest extraction and measures for resolving human-wildlife conflicts both had a negative influence on satisfaction. On the

other hand, respondents expressed satisfaction with their involvement in deciding conservation of pristine parts of the forest. Problems of wildlife-human conflicts and exclusion of people in conservation decisions are generally associated with negative attitudes towards conservation (Lepp and Holland, 2006). The positive influence of involvement in decisions about preserving pristine parts of the forest could be explained by QCMs' support of preservation of patches of the forest for traditional rituals by the local community.

In state-led protectionist approach of KWS, two aspects of management were significant in influencing the overall satisfaction ranking. These were; community involvement in decision to preserve unique parts of the forest and provision of employment opportunities for the local people which accounted for about 36% and 64% of the variation in the overall satisfaction respectively. The results of the marginal analysis in Table 4-9 showed that the current level of local people's involvement in conservation decision-making and also provision of employment for the locals had a negative influence on the probability of the respondents being satisfied. As noted earlier, people's exclusion in decision making and benefit sharing is associated with negative attitudes towards forest management authorities and vice versa. For example, Lepp and Holland (2006), found that employment of local people by the Kabale National Park in Uganda led to positive attitudes towards the park management.

4.5 Chapter Summary and Conclusions

There is a widespread consensus among researchers dealing with issues of natural resources management that people living close to these resources are critical in conservation. Therefore, there has been a rising interest in understanding the dynamics of management of natural resources and the local people in conservation in terms of their participation, livelihoods and the resulting outcomes. The focus of this Chapter was the satisfaction of the local communities with the performance of the existing three management approaches of Kakamega forest, factors that influence it and the relative weights of different aspects of forest management in determining the overall satisfaction. This was important because understanding how the local communities judge the

performance of the three forest management and factors that influence their judgment could provide insight on possible areas of intervention. Furthermore understanding the relative weights of different aspects of forest management in the overall satisfaction provides an opportunity to target efforts to the most important aspects. The satisfaction levels of local communities with the three forest management approaches were elicited through ranking scores based on a Likert scale of 1 (very satisfied) to 5 (very dissatisfied) both for the overall satisfaction and for 16 other different aspects of forest management. Analysis was done using several methods; descriptive statistics were used to assess the means and frequencies, ordered probit regression was used to analyse factors influencing satisfaction levels while an approach similar to conjoint analysis was used to assess the relative weights of different aspects of forest management in the overall satisfaction.

The results of descriptive analysis of satisfaction levels showed that the protectionist approach was ranked slightly higher than the incentive-based approaches. From this result, it cannot be conclusively concluded that local communities in the study area favor the protectionist management approach over incentive-based approaches. It could actually imply that local communities are willing to live with some level of strict conservation alongside regulated extraction. In essence this finding clearly indicates that in the study area, the local communities have an interest in conservation despite the need to extract from the forest. The finding goes contrary to popular thinking in many policy circles that local community objectives are always in direct contradiction with conservation objectives. Further as noted in the discussion of the results could also be viewed as the verdict of the community on how the three management approaches apply and enforce their rules. Good intentions of the incentive-based forest management could easily be undercut by lack of transparency in application of the rules i.e. people care about fairness as much as they care about the opportunity to extract. Therefore, it could be argued that allowing people to extract is only a necessary but not a sufficient condition for people to express satisfaction. Sufficient condition is met when people perceive that the rules are applied uniformly for everyone without favor or corruption.

The results of the ordered probit analysis revealed that there were some differences among the three management approaches with regard to factors that influence satisfaction. However, it is also important to note that only three out of ten variables were significant in explaining overall satisfaction in all the three management approaches. It could therefore be argued that satisfaction is by and large independent of the socio-economic characteristics of the respondents. Therefore, the satisfaction ranking could be viewed as being more of a reflection of a respondents' view of forest management rather than of his/her socio-economic status. Distance to market centers and level of education influenced satisfaction across all the three management approaches. The results showed that educated households and those located far from market centers were likely to be dissatisfied with all the three management approaches. The distance of the households from the forest margin had a negative effect on the satisfaction with the protectionist approach. Land size, a proxy for durable assets, negatively influenced satisfaction with the private incentive based approach of the QCM.

The results of 'conjoint' analysis revealed which management aspects were important to respondents across the three different management approaches. Further, the results revealed differences across management approaches on the relative importance of these different aspects of forest management. The incentive based management approach of FD has to direct its efforts to addressing problems associated with forest extraction especially the problems of impartiality in applying rules of extraction. On the other hand the quasi-private incentive-based approach should direct its efforts towards involving people in making extraction rules and resolution of wildlife-human conflicts. Further, it has to find the best way to address the problem of conflicts arising from wild animals damaging crops on farmers' fields. The protectionist management approach of KWS ought to pay more attention to providing more employment opportunities to the local people.

In general, the results of satisfaction analysis offer good insights on how the managers of the forest under the different approaches can improve their relationship with local communities by serving them better. Overall, the results clearly indicate that people are interested in conservation and therefore, forest managers and conservation policy makers

should consider local communities as partners in conservation rather than rivals. Since distance to markets and education are important in explaining satisfaction with all the three forest management approaches, they deserve special attention by policy makers. This study has shown how eliciting local communities' satisfaction with forest management can provide insights on their perception and possible areas of intervention. Further, ordered probit analysis has shed light on the relative importance of specific aspects of forest management for the local people. From these results forest managers are able to pinpoint which management aspects matter most to the people. Possible policy implications of these results are further discussed in Chapter 6.

5.0 LOCAL COMMUNITY PERCEPTIONS OF FOREST MANAGEMENT APPROACHES

5.1 Introduction

This Chapter present and discusses the results of analysis of local communities' perceptions of the three management approaches of Kakamega forest and factors influencing them. Section 5.2 discusses factor analysis as which was applied in analyzing perceptions. The results of factor analysis are presented in Section 5.3. Section 5.4 discusses the OLS regression results of perception scores while Section 5.5 provides the summary and conclusion of the Chapter.

5.2 Analytical Procedures

Local communities' satisfaction ranking of different aspects of forest management reflects some underlying or latent variables that represent their perceptions of forest management approaches. Factor analysis (FA) was applied to analyse the satisfaction rankings to gain an understanding of these latent variables. Factor analysis originated as a method to explore the relationships of attitudinal responses to the underlying latent variables. As described by Hair *et al* (1998), FA can be utilized to examine underlying patterns or relationships for a large number of variables and to determine whether the information can be condensed or summarized into a smaller set of factors or components. In essence FA reduces data set from a group of interrelated variables into smaller sets of uncorrelated factors and achieves parsimony by explaining the maximum amount of common variance in a correlation matrix using the smallest number of explaining concepts (Field, 2000). FA has been used by environmental economists to analyze public attitudes towards the environment (Nunes, 2002; Kline and Wichelns, 1998). The relationship between the observed and latent or underlying variables can be represented by the following matrix equation:

$$Y = \kappa Л + \delta \qquad (5\text{-}1)$$

Where Y is the $q \times 1$ vector of the n sets of observed variables (i.e. management aspects in this case), κ is the $q \times n$ matrix of regression coefficients (also called factor loadings) relating the management aspects to the underlying factors, Л is a 1 x n vector of latent variables (factor scores) that are estimated along with the coefficients; and δ is the $q \times 1$ vector of error terms of the management aspects ranking.

Several methods have been suggested for generating the factor scores with Bartlett and Anderson-Rubin being cited as the superior method because it produces scores that are unbiased and that correlate only with their own factors (Field, 2000). Linear components (variates or factors) of the matrix are calculated by determining the eingenvalues of the matrix. It is logical to retain only factors with large eigenvalues and in practice eigenvalues greater than 1 are usually considered large enough (Lise, 2000). To improve interpretation, factor rotation is carried out to discriminate between factors by ensuring that variables are loaded maximally to only one factor. There are several methods of rotating the matrices but varimax is commonly used because it attempts to maximize dispersion of loading within factors by assigning small loads to a smaller number of variables highly onto each factor resulting into more interpretable results. For large samples, small loadings can be considered statistically meaningful (a value of 0.4) is considered adequate (Field, 2000). The KMO and Bartlett's test of sphericity produce the Kaise-Meyer-Olkin measure of sample adequacy and KMO values that are greater that 0.5 indicate that the sample is adequate (Field, 2000).

Using the perception scores/factors as the dependent variables, several multiple linear regressions were estimated for each management approach to determine which independent variables influenced respondent's perceptions of the three forest management approaches. The regressions were specified as follows:

$$Л = \beta X + \mu_i \qquad (5\text{-}2)$$

Where Л is the i-th respondents' factor score corresponding to a given forest management approach; X is a vector of explanatory variables including the demographic,

socioeconomic, resource endowment characteristics of the respondent, β is a vector of regression parameters to be estimated and μ_i's are the vectors of disturbance terms in the regression. An increase in the value of the management factor score (JI) implies an increase in the level of dissatisfaction.

5.3 Results and Discussion

The results of factor analysis for the three management approaches are summarized in Tables 5-1, 5-2 and 5-3 for FD, QCM and KWS respectively. As noted earlier, the study retained factor loadings of 0.4 and above because in literature they are considered statistically significant for large samples (Field, 2000). The Kaiser-Meyer-Olkin (KMO) values for KWS, FD and QCM models were 0.682, 0.777 and 0.681 respectively, indicating acceptable sample adequacies across the three management approaches (Field, 2000; Lise, 2000). All the three models were significant as shown by high chi-square values of the Bartlett's test of sphericity (see Tables 5-1, 5-2 and 5-3). In general, respondents perceptions' of the forest management was expressed in three factor scores across the three approaches. Further discussions on the results are provided in subsequent paragraphs.

Under the FD management, the observed variations in respondents' perception of forest management were aggregated into three factor or perception scores. As shown by results in Table 5-1 management aspects such as local community participation in making rules of extraction, enforcement rules, and preservation of unique parts of the forests were loaded into factor 1. In addition, resolution of general conflicts and human-wildlife conflicts had some loading onto factor 1. Therefore factor 1 was labeled as 'involvement in decision-making' factor. It accounted for about 32 % of the respondent's variation in perceptions towards FD management approach. Factor 2 included factors such as promotion of environmental improvement activities, promotion of alternative energy sources, promotion of school outreach programs, provision of tree seedlings and promotion of alternative income sources. Therefore, this factor was labeled as 'mitigation' factor and it accounted for about 18% of variation in people's perception of FD's management.

Table 5-1: Factor analysis of community perception of FD management

	Factors scores		
Management aspects	Involvement in decision-making	Mitigation	Conservation incentives
EXT_RULE	0.766		
ENF_RULE	0.845		
DECN_CONS	0.492		
GEN_CONF	0.466		0.412
WILD_CONF	0.508		0.525
SCHL_OUT		0.733	
ENV_ACTV		0.782	
ALT_ENG		0.749	
TREE_SEED		0.780	
ALTINC_ACTV		0.541	
STR_RULE	0.528		
CLA_RULE	0.748		
LEV_EXTR	0.689		
EMP_LOC			0.762
PREV_CDMG			0.911
COMP_CDMG			0.882
Eigenvalue	5.165	3.010	1.643
% of total variance	32.28	18.81	10.27
Cummulative % of variance	32.28	51.09	61.36
Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.777			
Bartlett's Test of Sphericity Approximate Chi-square = 1246.57***			

Source: Own survey data, 2007

Prevention of crop damage by wild animals, compensation for crop damage, provision of employment to the local people were loaded onto factor 3 hence it was labeled 'conservation incentives' factor which accounted for about 10% of the variation in people's perception of FD.

Similarly, under the QCM management, the observed variations in respondents' perception of forest management were aggregated into three factor scores as summarized in Table 5-2. The results show that participation in designing extraction and enforcement rules, resolution of conflicts, and also outreach programs are loaded onto factor 1 which was labeled as 'involvement in decision making and conflicts resolution' factor. Factor 1 accounted for about 34% of the variation in local community perception of QCM management approach. Factor 2 included rules related mainly to the aspects of management; straightforwardness of extraction rules, clarity of enforcement rules and level of extraction allowed as well as mitigation related aspects. Therefore, factor 2 was labeled as 'extraction and mitigation' factor and it accounted for approximately 14 % of the variation in respondent perceptions of QCM management approach. Factor 3 mainly consisted of conservation related factors such prevention and compensation for crop damage, provision of employment for local people as well as people's involvement in conservation decision. This factor was labeled 'conservation incentives' factor and it accounted for about 11% of the variation in respondents' perception of QCM management approach.

Under the KWS management, the observed variations in respondents' perceptions of forest management were also aggregated into three factor scores. The results in Table 5-3 show that management aspects such as local community involvement in making rules of extraction, enforcement rules and preservation of unique parts of the forest as well as their perception of straightforwardness of extraction rules and clarity of enforcement of rules were loaded onto factor 1. Therefore, factor 1 was labeled as 'involvement in decision-making' factor and it accounted for about 30% of the total variation in respondents' perception of KWS forest management.

Table 5-2: Factor analysis of community perception of QCM management

	Factors		
Management aspects	Involvement in decision-making & Conflict resolutions	Extraction & Mitigation	Conservation incentives
EXT_RULE	0.842		
ENF_RULE	0.839		
GEN_CONF	0.798		
WILD_CONF	0.796		
SCHL_OUT	0.606	0.482	
ENV_ACTV	0.454	0.625	
ALT_ENG		0.555	
TREE_SEED		0.632	
ALTINC_ACTV		0.583	
STR_RULE		0.767	
CLA_RULE		0.781	
LEV_EXTR		0.617	
DECN_CONS			0.619
EMP_LOC			0.645
PREV_CDMG			0.795
COMP_CDMG			0.828
Eigenvalue	5.488	2.184	1.769
% of total variance	34.30	13.65	11.05
Cummulative % of variance explained	34.30	47.95	59.00
Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.681			
Bartlett's Test of Sphericity Approximate Chi-square = 739.49***			

Source: Own Survey2005/06

Factor 2 included issues related to conflicts resolution and mitigation programs and was therefore labeled as 'conflicts resolution and mitigation' factor. It accounted for approximately 21% of the variation in the respondent's perceptions of KWS forest management approach. Factor 3, consisted mainly of conservation incentives related issues such as provision of employment opportunities for local people, prevention of crop damage by wildlife and compensation of crop damage hence was labeled as 'conservation incentives' factor. Resolution of wildlife-human conflicts also had some loading on factor 3 which could be due to its close association with issues of crop damage. Factor 3 accounted for about 12% of the variation in the respondent's perceptions of KWS forest management approach.

Overall, factor analysis results show a strikingly common pattern of local community perceptions of the three forest management approaches. In general, local community perceive the performance of the three forest management approaches in three common dimensions; participation, mitigation and incentives in order of relative importance. In all the three management approaches, participation in decision-making emerged as the most important factor in explaining perception. This finding concurs with many studies which have pointed at the importance of involving local people in decision-making (Agrawal and Gibson, 1999; Lise, 2000; Kellert *et al,* 2000). Participation in decision-making enhances a sense of stewardship among the local communities which is important in the overall goal of conservation. Furthermore, many decisions taken by forest management have a direct impact on the livelihood of the local communities and it is therefore fair to involve them in decision-making.

Table 5-3: Factor analysis of community perception of KWS management

	Factors		
Management aspects	Involvement in decision-making & Extraction	Conflict resolutions & Mitigation	Conservation incentives
EXT_RULE	0.524		
ENF_RULE	0.928		
DECN_CONS	0.859		
SCHL_OUT	0.541		
STR_RULE	0.810		
CLA_RULE	0.911		
LEV_EXTR	0.627		
GEN_CONF		0.524	0.470
WILD_CONF		0.531	0.569
ENV_ACTV		0.692	
ALT_ENG		0.755	
TREE_SEED		0.661	
ALTINC_ACTV		0.752	
EMP_LOC			0.808
PREV_CDMG			0.887
COMP_CDMG			0.751
Eigenvalue	4.818	3.340	1.940
% of total variance	30.11	20.87	12.12
Cummulative % of variance explained	30.11	50.99	63.11
Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.673			
Bartlett's Test of Sphericity Approximate Chi-square = 546.05***			

Source: Authors' Computation, 2007

Involvement of local communities in the management of Kakamega forest has been done on an *ad-hoc* basis especially when the authorities required their support. As noted in Chapter 2, the three management approaches occasionally consult the local communities when making certain decisions especially through public meetings. However, it is not obligatory for the forest managers to involve the local people in making decisions. In the past Kenya's forest management legal framework did not provide for active participation of local communities in decision-making in forest management. However, as noted earlier, the new legal framework that came into effect in February 2007 explicitly provides for local communities to be active and legally recognized partners in forest management.

An overview of the three management approaches reveal that they all lack a clearly defined and structured procedures for resolving conflicts that arise between them and the local communities. For example, none of the management approaches have a functioning mechanism on how to deal with wildlife-human conflicts. Informal interviews with key informants indicated that none of the management has a formal way of dealing with wildlife conflicts or even compensating for the damage whenever it occurs. Mitigating the effects of negative impacts of conservation especially crop damage by wild animals is critical in ensuring positive attitudes towards conservation among the local communities (Lepp and Holland, 2006). Providing the local communities with mitigation measures such as alternative sources of forest products e.g. promoting planting of trees on their farms is important for easing pressure on the forest. As noted earlier each of the management approaches are involved in some form of mitigation activities; FD operates a tree nursery which it uses to disseminate tree seedlings to the local people at subsidized prices. The main challenge however is budgetary constraints which limit the reach of these programs. As noted earlier the incentive-based approaches of FD and QCM offer the local communities conservation incentives by allowing local communities some regulated extraction from the forest. Section 5.2 explores factors that explain these perceptions by use of regression analysis.

5.4 Regression Analysis of Community Perceptions of Forest Management Approaches

The identified factor scores were regressed against a set of explanatory variables that were postulated to influence the respondents' perceptions. The results of OLS regression for respondent's perception of FD, QCM and KWS management approaches are summarized in Tables 5-4, 5-5 and 5-6 respectively. Identical independent variables were used in all the nine regressions except in factor 1 in FD from which crop damage (CROP_DMG) was excluded because it was deemed irrelevant in explaining the model.

As shown by the results, different variables were significant in influencing different perceptions across the three management approaches. This indicates uniqueness of each perception in the different management approaches since they could not be predicted by the same variables. With the exception of Factor 1 and 2 under KWS, the models had low R^2 values. This can be attributed to respondent specificity of forest management perceptions. Actually, low R^2 is indicative of the relevance of underlying factors in the sense that the factor scores, when contrasted to the individual characteristics, contain additional information for the characterization of respondent's profile (Nunes, 2002). In addition, regression based on cross-sectional data generally results in low values of R^2 (Greene, 2003). All the models had significant values of F-statistic indicating that all the coefficients of the independent variables were significantly different from zero. As noted in Section 2.7, an increase in the value of factor score implies an increase in the level of dissatisfaction hence a factor with a positive effect on the factor score means that it is associated with increasing dissatisfaction and vice versa.

Membership to social groups (SGRP_MEM) had a significant influence on perception only under the protectionist-oriented management approach of KWS despite relatively similar levels of membership to social groups under the FD approach (66%) compared to 61% in KWS. SGRP_MEM had positive influence on people's perception about their 'involvement in decision-making and conflict resolution' but it had a negative influence on 'extraction and mitigation' and 'conservation incentives'. It could be argued that respondents who

belonged to social groups could have used the groups as avenues for lobbying for more participation in making conservation decisions and resolving conflicts.

Table 5-4: OLS results of respondent's perception of FD management approach

Variables	Involvement in decision-making	Mitigation	conservation incentives
Constant	0.9133* (0.5265)	1.0966 (1.1502)	-0.4426 (1.0998)
SGRP_MEM	0.1426 (0. 1925)	-0.1046 (0.1907)	0.1811(0.1903)
FRST_DIST	0.0878**(0.0375)	-0.0539 (0.0402)	0.1148*** (0.0377)
HH_SEX	-0.1186 (0.2545)	0.1006 (0.2861)	0.4932 (0.2799)
AV_EDUC	-0.0446 (0.0402)	0.1219*** (0.0429)	0.0013 (0.0412)
FRST_DEP	0.3991* (0.2365)	-0.5269***(0.2641)	-0.2982 (0.2582)
FARM_SZ	0.0692 (0.0613)	-0.1839**(0.0888)	0. 0936 (0.0855)
LVST_UNIT	-0.2095**(0.0961)	-0.0459 (0.0964)	0.0595 (0.0968)
MRKT-DIST	-0.2185***(0.0416)	0.0033 (0.0481)	0.0131 (0.0458)
AGE_HH	-0.0014 (0.0067)	0.0075 (0.0072)	0.0036 (0.0073)
CROP_DMG		-0.7789(0.5026)	-0.4425 (1.0999)
F-statistic	4.48***	1.67*	3.34***
ADJ R^2	0.25	0.07	0.21

Source: Own Survey, 2005/06

On the other hand, people who did not belong to social groups might have lacked 'safety net' associated with membership to social groups hence their negative view of extraction, mitigation and incentive efforts of the protectionist approach of KWS. Distance from the forest edge (FRST_DIST) was significant in explaining at least one dimension of perception in all the three models. Under the protectionist management approach of KWS the further away the respondents were from the forest the more likely they had a positive perception on 'extraction and mitigation' factor. This finding is consistent with previous studies which found that people living further away from the forest had more positive attitudes towards conservation, mainly because they did not suffer crop damage by wild

animals (Shrestha and Alavalapati, 2006). Under the incentive-based approach of FD distance from forest had a negative influence on people's perception of 'involvement in decision-making' and 'conservation incentives'. This finding is expected because with increasing distance from the forest people are likely to have increasingly less interaction with forest management.

Table: 5-5: OLS results of respondent's perception of QCM management approach

Variables	Involvement in Decision-making & Conflict resolution	Extraction & Mitigation	Conservation incentives
Constant	0.4887 (1.9003)	-0.1367 (0.8969)	1.1380 (1.8122)
SGRP_MEM	-0.3838 (0.3598)	-0.1598 (0.3385)	-0.2324 (0.4621)
FRST_DIST	0.5061 (0.5888)	-1.3384***(0.2722)	0.6532 (0.6211)
HH_SEX	0.2602 (0.3457)	0.2137 (0.2715)	-0.0870 (0.3726)
AV_EDUC	0.0775 (0.0671)	-0.1511***(0.0526)	0.1581**(0.0721)
FRST_DEP	-1.0642**(0.4958)	-1.2345***(0.4288)	0.1974 (0.5733)
FARM_SZ	-0.7600*** (0.2978)	0.1224 (0.2376)	0.1443 (0.3437)
LVST_UNIT	0.0023 (0.1551)	0.0599(0.1190)	0.1737 (0.1584)
MRKT-DIST	0.1971 (0.1261)	-0.1754 (0.2135)	0.2424 (0.2860)
AGE_HHH	0.0345***(0.0122)	0.0422***(0.0102)	-0.0081 (0.0136)
CROP_DMG	-0.0103 (0.9845)	0.5392 (0.4722)	-1.3780 (0.9958)
F-statistic	2.31*	6.19***	2.03*
ADJ R^2	0.26	0.67	0.27

Source: Own Survey, 2005/06

Under incentive management of QCM, increasing distance from the forest positively influenced perception about 'extraction and mitigation' factor. As noted in the Chapter 1 (Section 1.7), respondents under QCM were closest to the forest edge compared to those under KWS and FD. It could therefore be argued that even those further away, were still close enough to utilize the opportunity to extract from the forest. The gender of the

household head (HH_SEX) had a positive influence on people's perception of 'involvement in decision-making and conflict resolution' under KWS but it had no significant influence on any dimension of perception under FD and QCM. This means that male household heads were more likely to have positive perception about their involvement in decision-making under KWS. This could be explained by cultural setting of the study area where men are more involved in decision-making than women. The average education level of the household (AV_EDUC) had a negative influence on people's perception about 'extraction and mitigation' and 'conservation incentives' under the KWS management approach. It also had a negative influence on 'mitigation perceptions' in FD and 'conservation incentives' in QCM but it positively influenced 'extraction and mitigation' under QCM. Overall, education increases the respondent's awareness of conservation matters and many studies have found positive association between education and conservation attitudes (Lise, 2000; Shrestha and Alavalapati, 2006). High level of education is likely to raise a respondent's expectation of the performance of forest management performance hence more likely to increase negative perception if these expectations are not met.

Dependency on forest (FRST_DEP) influenced at least one of the dimensions of perception across all the three management approaches. This indicates that dependency on forest is an important factor in determining respondents' perceptions of forest management. It had a negative influence on perception about 'involvement in decision-making and conflict resolution' in KWS and 'involvement in decision making' under FD. On the other hand, FRST_DEP had a positive influence on 'mitigation' perception under FD and 'extraction and mitigation' under QCM. This means that respondents who did not depend on the forest were unsatisfied with their involvement in decision making in both KWS and FD. On the other hand, those who depended on the forest were happy with the mitigation and extraction offered by FD and QCM. This finding fits well with other studies which have found positive attitudes towards conservation where individuals obtain some direct economic benefits (Bauer, 2003; Michelle, 2005; Walpole and Goodwin, 2001). As expected crop damage (CROP_DMG) had a negative influence on respondents' perception of 'extraction and mitigation' but surprisingly it had a positive influence on respondent's

perception of 'conservation incentives' under KWS management. Although unexpected, it is not all together surprising to find positive attitudes despite crop damage. A study carried out in India by Sekhar (1998) found that people had positive attitudes towards the Sariska Tiger Reserve despite crop damages because of the tangible extractive benefits such as fuel wood and fodder as well as cultural/religious reasons. For the case of Kakamega forest, the results could be explained by the more overwhelming approval of the conservation efforts of the protectionist approach by the local community coupled with low levels of crop damage.

Table 5-6: OLS results of respondent's perception of KWS management approach

Variables	Involvement in decision-making & conflict resolutions	Extraction & Mitigation	Conservation incentives
Constant	0.3766 (1.0193)	-1.3929 (1.2181)	2.5947 (2.0497)
SGRP_MEM	-0.8591*** (0.2599)	1.4947*** (0.3736)	0.8116** (0.3511)
FRST_DIST	0.1444 (0.0996)	-0.5005 (0.1048)***	0.1698 (0.1274)
HH_SEX	-0.7693* (0.3949)	-0.5409 (0.5637)	-0.9088* (0.6799)
AV_EDUC	-0.0472 (0.0504)	0.4326*** (0.0806)	0.2338** (0.0946)
FRST_DEP	0.6097* (0.3226)	-0.6977 (0.3496)	-0.8144 (0.7170)
FARM_SZ	0.1001** (0.466)	-0.4084***(0.0975)	-0.1599 (0.1096)
LVST_UNIT	0.0047 (0.0204)	-0.0878*** (0.0219)	-0.0110 (0.1650)
MRKT-DIST	-0.0891(0.0807)	0.0964 (0.0815)	-0.2158 (0.1492)
AGE_HH	0.0095 (0.0097)	-0. 0034 (0.0119)	-0.0026 (0.0168)
CROP_DMG	0.3268 (0.3154)	0.7212* (0.3269)	-1.6722*** (0.5460)
F-statistic	6.25***	7.93**	3.04**
ADJ R^2	0.88	0.83	0.45

Source: Own Survey, 2005/06

Farm size (FARM_SIZE) negatively influenced perception about 'involvement in decision making and conflict resolutions' but it had a positive influence on 'extraction and mitigation' under the protectionist of KWS. Under the incentive based management of approach of FD farm size had a positive influence on 'mitigation' and 'involvement in

decision making and conflict resolution' under the QCM management. Number of livestock units (LVST_UNIT) had a positive influence on 'extraction and mitigation' under KWS and 'involvement in decision-making' under FD. Since both FARM_SIZE and LVST_UNIT measured the level of household's resource endowment it means that wealthier households were satisfied with the existing protectionist approach of KWS but were dissatisfied with their involvement in decision-making. Under FD management, wealthier households were satisfied with the current mitigation efforts while under QCM management, they were satisfied with the current level of their involvement in decision making. Generally, wealthier households were satisfied with extraction allowed and mitigation but were not satisfied with their current level of participation in decision-making. Distance to market (MRKT_DIST) had a positive influence on perception of 'involvement in decision-making' under the FD management approach. It can be interpreted to mean that respondents that were closer to market centers were more satisfied with the current level of their involvement in decision making under FD management. Age of the household head (AGE_HH) had a negative influence on perception about 'involvement in decision-making and conflicts resolution' under the QCM forest management but it did not have significant influence in any other dimension of perception across the management approaches. This means that older farmers were unsatisfied with the current level of involvement in decision-making under QCM management. The next Section gives the summary and conclusions of the Chapter.

5.5 Chapter Summary and Conclusions

Chapter 5 provided an insight into the perceptions of local communities about the three management approaches of Kakamega forest. The study applied factor analysis to analyze the underlying dimensions of satisfaction ranking of 16 different aspects of forest management. Further, ordinary least squares (OLS) regression was applied to determine the effect of demographic, socioeconomic, biophysical and resource endowment characteristics of the respondents on these underlying dimensions.

Results of the factor analysis showed that 16 aspects of management could be reduced into 3 factors or perception scores in all the three forest management approaches. Despite some

differences in factor loadings across management approaches, issues of community involvement in decision making processes in forest management were loaded onto the first factor in all the three management approaches. This is indicative of the relative importance that people put on their involvement in decision making and therefore forest management ought to widen opportunity for community participation in decision making processes. Other important factors included 'mitigation'/'extraction', 'conflict resolution' and 'conservation' incentives in various combinations.

Regression results showed that perception scores were influenced by different set of demographic, socioeconomic, biophysical and resource endowment characteristics of the respondents such as farm size, membership to social groups, distance of household from forest margin, distance from market centers and whether or not the household suffered any crop damage by wild animals. This implies that in order to address peoples' interest in forest conservation, there is need for forest managers to pay attention to the fact that different sets of factors influence their perceptions. Broadly, membership to social groups could increase peoples' collective bargaining power for more involvement in decision-making processes of forest management. Investment in education could increase conservation consciousness of the people hence promote long term conservation goals. Offering people direct forest extraction incentives could increase more positive attitudes towards conservation but this must be accompanied with strict enforcement to prevent forest degradation. Therefore, the results of this study provide the forest managers with a good understanding of the general perception of the local communities towards the management and also provide further information on possible areas of intervention. Further policy implications of the results are discussed in the next Chapter.

6.0 SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

6.1 Recap of the Research Problem and Objectives of the Study

Kakamega forest in Western Kenya exists as an island rich in biodiversity surrounded by poor farming communities who depend on it for necessities such as fuel wood, fodder/grazing, thatch grass and charcoal. Over the years the Forest has been under immense degradation pressure and its survival in the future is projected to be in jeopardy. To ensure its survival in the future, it is very necessary to explore whether the current management approaches meet the dual goal of conservation while also meeting the expectations of different stakeholders. In addition, it is also important to characterize the relations that exist between the local communities and the forest management in order to shed light on how interactions between them can be improved to meet goals of conservation. The Forest is currently managed under three management approaches each carrying out its functions in a different style; a state-led incentive based approach of the FD, a private incentive-based approach of the QCM and a state-led protectionist approach of KWS.

Being an economic resource, the forest ought to be managed in an economically efficient manner. Economic considerations require that over time resources spent in the management of the forest should generate positive net returns; otherwise it would be a waste of resources. In addition to efficiency concerns, and equally important the distribution of costs and benefits from the utilization and conservation of the forest should not benefit some members of the society at the expense of others. Although equity concerns do not necessarily fall under the jurisdiction of economics, ignoring them is unwise since they could actually undermine conservation efforts. The pattern of distribution of costs and benefits actually determines who is for or against conservation among different stakeholders i.e. losers will be against conservation and vice versa. Another very important consideration is the approval and cooperation of the local communities which is critical for successful conservation. A wide range of researchers have asserted that success or failure of conservation interventions depends on the approval and support of the local people or lack of it. The approval of the local communities with the performance of forest

management can be assessed through their satisfaction levels. Understanding the satisfaction levels of the local communities and their perceptions of the three management approaches could provide insights on how the management can be more responsive to the needs of the local people.

Given this background this study set out to analyze the economic efficiency of the three existing forest management approaches of Kakamega forest as well as distribution of costs and benefits between local communities, the nation and the global community. Further, the study attempted to analyze the satisfaction and perception of the local communities towards the three forest management approaches and the factors influencing them. The major findings of the study are highlighted in the next Section.

6.2 Summary of the Major Findings

6.2.1 Distribution of Costs and Benefits of Conserving and Utilizing Kakamega Forest

Empirical results presented in Chapter 3 showed that distribution of costs and benefits of conservation between stakeholders is unevenly distributed. The global community derives the highest proportion of benefits relative to costs while the local communities bear the large proportion of the costs relative to benefits. In essence local communities subsidize the conservation of the forest on behalf of the society by bearing the burden of its opportunity costs. A closer look revealed some differences between the different management approaches in the distribution of costs and differences. The protectionist approach, due to its strict policy of non-extraction generates the least direct use benefits to the local communities per unit area but it generates the highest benefits to the nation and global community for recreational and carbon storage purposes. On the other hand the private approach of QCM generates the highest level of benefits to the local communities per unit area of the forest mainly due to its small size relative to extracting population. It is however important to point out that there appears to be an inverse relationship between the level of benefits generated and biodiversity conservation (where the status of forest degradation used as the proxy). The protectionist approach scores highest in conservation while the private approach scores the lowest. In general, the distribution of costs and benefits is skewed against the local communities while being in favor of the global community.

6.2.2 Financial and Economic Worthiness of Forest Management Approaches

Cost-benefit analysis of the three management approaches was carried out using conservative estimates of the major parameters. Using the current annual rates of forest degradation or regeneration to approximate rate of flow of benefits and the opportunity cost of capital as the discount rates the study applied the framework of CBA to generate the NPV for the three management approaches. The findings of this study clearly indicate that from a global of view all the three management approaches of Kakamega forest are economically efficient in carrying out their conservation functions. On the contrary, financial CBA (carried out from the perspective of the local people) indicated that the incentive based management of QCM was economically efficient but incentive based approach of FD and protectionist approach of KWS were not economically efficient. This was mainly due to very intensive use of the small part of the QCM by a relatively large population. Similar observations were made at the national level where the FD and KWS management failed the test of worthwhile projects but QCM passed the test. Sensitivity was carried out by considering significant variations in discount rates and future flows of benefits on the NPV's. The results of sensitivity analysis showed that the results of the CBA models are stable to these variations.

6.2.3 Local Community Satisfaction Levels with Forest Management Approaches and their Determinants

The study examined the levels of community satisfaction with the existing forest management approaches of Kakamega forest and provided insight on factors that influence these satisfaction levels. Satisfaction ranking data was analyzed using both descriptive statistics and ordered probit regression. The results of overall mean satisfaction indicated that the protectionist management approach was ranked relatively higher for its management of the forest than the incentive-based management approaches. However, from the result it could not be conclusively argued that local communities in the study area favor the protectionist management approach over incentive-based approaches. The results could be interpreted as being local communities' verdict on how the three management approaches apply and enforce their rules. This finding clearly indicates that in the study area, the local communities would like to see the forest (or at least part of it) conserved

despite the need to extract from it. Therefore, forest managers and conservation policy makers should consider local communities as partners in conservation rather than rivals. In additional forest managers should note that it is not enough just to allow people to extract from the forest without enforcing their rules uniformly.

Ordered probit analysis revealed that there were some differences among the three management approaches with regard to factors that influenced satisfaction levels. Distance to market centers and level of education influenced satisfaction across all the three management approaches. The results showed that educated households and those located far from market centers were likely to be dissatisfied with all the three management approaches. The distance of the households from the forest margin had a negative effect on the satisfaction with the protectionist approach. Land size, a proxy for durable assets, negatively influenced satisfaction with the private incentive based approach of the QCM. Since distance to markets and education are important in explaining satisfaction with all the three forest management approaches, they deserve special attention by policy makers.

6.2.4 Relative Weights of Different Management Aspects in the Overall Satisfaction

This study applied an approach closely similar to conjoint analysis to analyse the relative weights of specific aspects of forest management in the overall satisfaction with forest management. In the first stage, the study estimated an ordered probit regression to determine which management aspects were significant in explaining the overall satisfaction among the respondents across the different approaches. In the second stage, the relative weights of the significant aspects of forest management were determined. The results indicated that under the incentive-based management of FD, the level of forest extraction that is currently allowed was the most important management aspect. On the other hand under the private incentive-based approach participation of people in making extraction rules and resolution of wildlife-human conflict were the most important management aspects. Under the protectionist management approach of KWS provision of more employment opportunities to the local people was the most important management aspect. To win the support of the local people, it has to allocate more employment opportunities to local people while endeavoring to involve the people more in conservation decisions.

Realization of economic benefits by the local communities would have a positive influence on satisfaction with forest management.

6.2.5 Local Community Perceptions of Different Forest Management Approaches and their Determinants

This study attempted to shed light into the perceptions of local communities about the three existing management approaches of Kakamega forest. Towards this end, the study applied factor analysis to analyse the underlying dimensions of satisfaction ranking of 16 different aspects of forest management. Further, the study applied ordinary least squares regression to determine the effect of demographic, socioeconomic, geophysical and biophysical characteristics of the respondents on these underlying dimensions. Results of the factor analysis showed that 16 aspects of management could be reduced into 3 factors or perception scores in all the three forest management approaches. Despite some differences in factor loadings across management approaches, issues of community involvement in decision making processes in forest management were loaded onto the first factor in all the three management approaches. This is indicative of the relative importance that people place on their involvement in decision making and therefore forest management ought to widen opportunities for community participation in decision making processes. Other important factors included 'mitigation'/'extraction', 'conflict resolution' and 'conservation' incentives in various combinations. Regression results showed that perception scores were influenced by different set of demographic, socioeconomic, geophysical and biophysical characteristics of the respondents such as farm size, membership to social groups, distance of household from forest margin, distance from market centers and whether or not the household suffered any crop damage by wild animals.

6.3 Recommendations and Policy Implications

The results of the study point out possible policy interventions that are worth considerations by conservation policy makers. Important conclusions of the study and their policy implications are set out below:

- The distribution of costs and benefits of conservation arising from Kakamega forest clearly indicate that local communities subsidize its conservation on behalf of the

global community. Therefore, for purposes of equity and more importantly for continued support of conservation efforts, an appropriate compensatory mechanism should be established that would target the local communities. However, the establishment of such mechanism would depend on whether or not there currently exists any transfer program from the global community and whether or not it fully compensates the local people of the cost that they bear.

- Assessment of economic efficiency of the forest management approaches revealed that with the exception of privately managed QCM, the other two state-led management approaches were unprofitable from the local and national perspective. Therefore, there is an urgent need to put in place measures that would increase their profitability. For example, the recreational value of the forest is currently underutilized especially the FD managed part; management should initiate an entry fee for tourists immediately. In additional it should upgrade and further develop other tourist attractions in the forest, for example, nature trails, camping sites e.t.c. Even in the KWS managed part, there still exists some potential to further increase earnings from tourism especially by more aggressive marketing and advertisement both domestically and internationally. Being a government forest, this can be done cheaply through the already established government advertising channels. To arouse interest nationally, KWS should consider offering occasional offers of entry into the forest at reduced entry fees e.t.c.
- Some of the costs of conservation could easily be reduced if appropriate measures are taken. For example, transaction costs could be lowered by providing information on types of forest products available in the market and their prices. Further, measures for standardizing the units for measuring quantities of forest products would lower asymmetries of information between buyers and seller and hence lower transaction costs.
- Satisfaction results showed that local communities have interest in conservation. Closer partnerships in conservation for example co-management can be built between state agencies and local communities to ensure success in meeting conservation goals. The finding also fits well with the proposed new approach of co-management that FD plans to adopt in the near future. Under the proposed new

plan, the community will play a lead role in deciding all matters concerning conservation and use of the forest while FD will play a facilitation role. The satisfaction results also suggest that local communities care about fair and transparent implementation of extraction rules. All the three management approaches ought to establish and strictly adhere to principles of transparency and accountability. For example, the top management of the forest should establish channels for the local communities to report any corrupt activities by the forest guards.

- The overall national development goals of increasing incomes earning opportunities by integrating communities in modern economy could favor conservation efforts. Investing in education would favor not only positive attitudes towards conservation but would make the local communities more enlightened about their rights in participating in conservation processes. This implies that in order to address people interest in forest conservation, there is need for forest managers to pay attention to these factors. Broadly, membership to social groups could increase peoples' collective bargaining power for more involvement in decision-making processes of forest management. This finding fits well with the new forest law which allows people to organize and form forest management associations to jointly manage the forest with the FD. Investment in education could increase conservation consciousness of the people hence promote long term conservation goals. Offering people direct forest extraction incentives could increase more positive attitudes towards conservation but this must be accompanied with strict enforcement to prevent forest degradation.
- The incentive based management approach of FD has to direct its efforts to addressing problems associated with forest extraction especially the problems of impartiality in applying rules of extraction. On the other had the private incentive-based approach of QCM should direct its efforts towards involving people in making extraction rule and resolution of wildlife-human conflicts. However, since it manages the forest privately, the onus is on the management, to determine the level to which to involve the community. But whatever decision it makes, support of the local community is needed to ensure continued conservation of the remaining

forest. Further, it has to find the best way to address the problem of conflicts arising from wild animals damaging crops on farmers' fields. The protectionist management approach of KWS ought to pay more attention to providing more employment opportunities to the local people. For example, in the process of recruiting forest guards, the management can introduce a quota system which would set apart a number of positions for the local communities. In addition, KWS should endeavor to involve people more in the decision-making processes through holding more frequent public meetings or allowing the community to elect a few representatives as members of decision-making board. This would ensure that the interests of the people are represented in decision making.

6.4 Insights for Future Research

The findings of this study provide insights on areas that require further research in the future. As noted in Chapter 3 there is limited understanding about the dynamics of ecosystem services that are currently provided by Kakamega forest and the interactions between them. Future ecological studies could provide more information base for more informed and accurate economic valuation. Furthermore, the current level of forest extraction allowed is not based on sound ecological reasoning or information. Future research should provide more accurate data on rates of regeneration and off take in order to come up with sustainable harvesting regimes for different forest products

The current study evaluated local communities' satisfaction levels and perceptions of the existing forest management approaches but not about alternative or possible management approaches. Therefore, future research could explore from the perspective of all stakeholders what other forms of management approaches or their variants that they would prefer. This would provide a wider scope of information for policy decision on forest management.

This study provided an insight on aggregate distribution between groups of stakeholders at the local, national and global level. Future research should try to answer the finer questions

about intra communal distribution. For example which income groups among the local people bear the highest cost of conservation?

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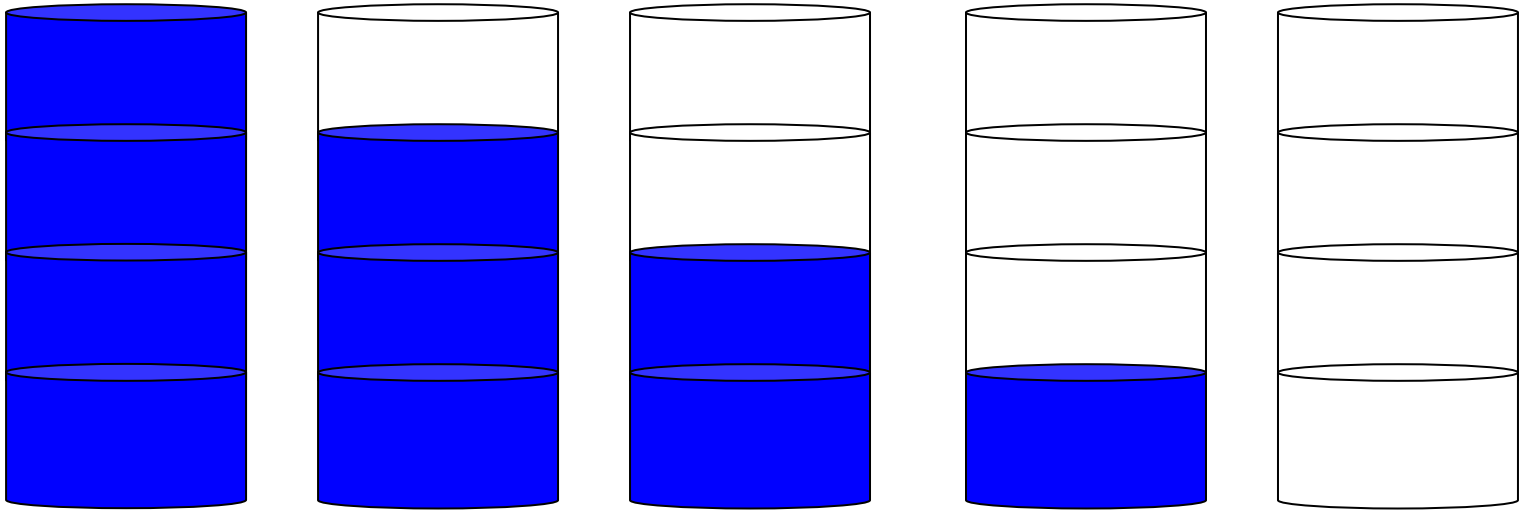
Appendices

Appendix 1: Pictorial Representation of Satisfaction Levels



1. V. Satisfied 2. Satisfied 3. Neutral 4. Dissatisfied 5. V. Dissatisfied

Appendix 2A: Spearman Rank Correlations Between Different Aspects of Forest Management under FD

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16
EXT_RULE (S1)	1.00															
ENF_RULE(S2)	0.61	1.00														
CONS_DEC(S3)	0.37	0.88	1.00													
GEN_CONF(S4)	0.16	0.11	0.01	1.00												
WILD_CONF(S5)	0.22	0.16	0.03	0.73	1.00											
SCHL_OUT(S6)	-0.11	0.41	0.45	0.06	0.14	1.00										
ENV_ACT(S7)	-0.20	0.11	0.11	0.30	0.23	0.38	1.00									
ALT_ENG(S8)	0.05	0.28	0.24	0.31	0.29	0.27	0.44	1.00								
TREE_SEED(S9)	0.08	-0.11	-0.21	0.24	0.23	-0.13	0.35	0.40	1.00							
STR_RULE (S10)	0.12	0.04	-0.03	0.32	0.40	0.03	0.21	0.52	0.40	1.00						
ALT_INC(S11)	0.63	0.72	0.60	0.21	0.44	0.30	0.13	0.40	0.04	0.28	1.00					
CLA_RULE(S12)	0.57	0.83	0.73	0.08	0.20	0.53	0.09	0.27	-0.21	0.12	0.74	1.00				
LEV_EXTR(S13)	0.17	0.49	0.44	0.35	0.43	0.54	0.33	0.41	0.03	0.24	0.56	0.48	1.00			
EMP_LOC(S14)	-0.23	-0.21	-0.20	0.14	0.15	0.07	-0.11	-0.12	-0.02	0.12	0.25	-0.21	0.11	1.00		
PREV_CDMG(S15)	-0.05	-0.12	0.20	0.13	0.29	0.06	-0.04	-0.13	0.11	0.08	-0.08	-0.08	-0.01	0.80	1.00	
COMP-DMG(S16)	-0.14	-0.41	-0.47	0.30	0.38	-0.10	0.13	-0.01	0.31	0.20	-0.28	-0.32	-0.07	-0.32	0.69	1.00

Appendix 2B: Spearman Rank Correlations between Different Aspects of Forest Management under QCM

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16
EXT_RULE (S1)	1.00															
ENF_RULE(S2)	0.80	1.00														
CONS_DEC(S3)	-0.06	-0.20	1.00													
GEN_CONF(S4)	0.56	0.56	-0.48	1.00												
WILD_CONF(S5)	0.57	0.62	-0.05	0.70	1.00											
SCHL_OUT(S6)	0.49	0.51	-0.20	0.46	0.54	1.00										
ENV_ACT(S7)	0.28	0.34	0.02	0.42	0.38	0.68	1.00									
ALT_ENG(S8)	0.17	0.04	-0.15	0.34	0.40	0.40	0.37	1.00								
TREE_SEED(S9)	0.18	0.27	-0.03	0.31	0.27	0.39	0.51	0.40	1.00							
STR_RULE (S10)	0.33	0.43	-0.09	0.38	0.47	0.45	0.41	0.65	0.36	1.00						
ALT_INC(S11)	0.26	0.06	-0.21	0.16	0.27	0.44	0.30	0.41	0.35	0.38	1.00					
CLA_RULE(S12)	0.14	0.17	0.04	0.05	0.10	0.30	0.30	0.08	0.26	0.26	0.70	1.00				
LEV_EXTR(S13)	0.40	0.41	-0.01	0.31	0.40	0.45	0.37	0.20	0.25	0.37	0.53	0.58	1.00			
EMP_LOC(S14)	0.01	0.04	0.37	0.17	0.13	-0.29	0.22	0.07	0.20	0.34	0.13	0.17	0.06	1.00		
PREV_CDMG(S15)	0.22	0.27	0.19	0.27	0.36	0.36	0.28	0.26	0.07	0.48	0.35	0.24	0.39	0.46	1.00	
COMP-DMG (S16)	0.05	0.13	0.26	0.25	0.35	0.25	0.23	0.33	0.05	0.34	0.31	0.11	0.26	0.42	0.81	1.00

Appendix 2C: Spearman Rank Correlations between Different Aspects of Forest Management under KWS

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16
EXT_RULE (S1)	1.00															
ENF_RULE(S2)	0.61	1.00														
CONS_DEC(S3)	0.37	0.88	1.00													
GEN_CONF(S4)	0.16	0.11	0.01	1.00												
WILD_CONF(S5)	0.22	0.16	0.03	0.73	1.00											
SCHL_OUT(S6)	-0.10	0.41	0.45	0.06	0.14	1.00										
ENV_ACT(S7)	-0.20	0.11	0.11	0.29	0.23	0.38	1.00									
ALT_ENG(S8)	0.53	0.28	0.24	0.31	0.29	0.23	0.38	1.00								
TREE_SEED(S9)	0.08	-0.11	-0.21	0.24	0.23	-0.13	0.35	0.43	1.00							
STR_RULE (S10)	0.12	0.04	-0.03	0.32	0.40	0.03	0.40	0.03	0.21	1.00						
ALT_INC(S11)	0.63	0.72	0.60	0.21	0.44	0.30	0.13	0.40	0.04	0.28	1.00					
CLA_RULE(S12)	0.57	0.83	0.73	0.08	0.20	0.53	0.09	0.27	-0.21	0.12	0.74	1.00				
LEV_EXTR(S13)	0.17	0.49	0.44	0.35	0.43	0.54	0.33	0.41	0.03	0.24	0.56	0.48	1.00			
EMP_LOC(S14)	-0.23	-0.21	-0.20	0.19	0.15	0.07	-0.14	-0.12	-0.12	-0.21	-0.25	0.21	0.11	1.00		
PREV_CDMG(S15)	-0.05	-0.12	-0.19	0.13	0.29	0.58	-0.04	-0.13	0.11	0.68	-0.08	-0.08	-0.01	0.80	1.00	
COMP-DMG (S16)	-0.14	-0.41	-0.47	0.30	0.38	-0.10	0.13	-0.12	0.31	0.20	-0.28	-0.32	-0.07	0.50	0.69	1.00

Appendix 3: Household Questionnaire

ANALYSIS OF INTERACTION BETWEEN FOREST AND RURAL LIVELIHOODS IN KAKAMEGA DISTRICT

Research Undertaken by the Centre for Development Research (ZEF)

Bonn, Germany

No.

FIELD QUESTIONNAIRE (for Farmers)

[UPPER CASE LETTERS ARE ENUMERATOR COMMENTS]

THE ENUMERATOR SHOULD INFORM THE RESPONDENT THAT INFORMATION HE OR SHE WILL GIVE WILL BE HANDLED CONFIDENTIALLY AND WILL BE USED FOR RESEARCH PURPOSE ONLY

PART I: Identification

Name of the enumerator……

Date of the interview……

Name of the respondent:……

Name of household head (if different from the respondent)……

District:……Division:……Location:……

Sub-Location…… Village…….

PART II: Land Use and Household

The following questions concern the profile of your farm (s) ALL AREAS IN ACRES

Table 1: Farm Profile

Farm Identification	Size in Acres	Area under Crops (including fruits & vegetables & fodder crops)	Area Grazed	Area under Trees (Farm forest)	Unusable land	Tenure status [Owned (titled)=1, *Owned (not titled)=2 Rented=3*]	Method of Acquisition [*Bought=1, Gift=2 Inherited=3, Rented=4 other (specify)*]
Main Farm (Homestead)							
Farm 2							
Farm 3							
Farm 4							

2.1 Do you usually use fertilizers (organic and chemical) for some of your crops? …….. [*yes = 1/no = 0*]

If yes:

Codes 2
Chemical = 1
Organic = 2
Both = 3

Table 2: Fertiliser Use

	Crop Names [Codes 1]	Fertiliser Type [Codes 2]
1.		
2.		
3.		
4.		
5.		
6.		

Codes 1
Maize = 1
Bean = 2
Tea = 3
Sugar cane = 4
Irish Potatoes = 5
Sweet Potatoes = 6
Fodder crops = 7
Vegetables = 8
Other (specify)

The following questions concern the crops you grow on your farm (s) starting from the long season in February 2005)

INLCUDE ALL PLOTS FROM ALL FARMS LISTED IN TABLE 1 AND CONVERT TO ACRES; ALSO CONVERT QUANTITIES TO THE COMMON METRIC UNITS WHENEVER POSSIBLE; REPEAT PERMANENT/PERENNIAL CROPS (E.G. TEA, CANE) IN THE SAME ROW FOR THE SHORT SEASON; INCLUDE VEGETABLE GARDENS (CODE 8); INCLUDE COMMERCIALLY CULTIVATED VEGETABLES OR FRUITS INDIVIDUALLY WITH THEIR NAME.

Table 3a: TABLE LONG SEASON (FEBRUARY 2005 TO AUGUST 2005)

ID	Parcel Size in Acres	Main Crop *[Code Box 1]*	2nd Crop *[Code Box 1]*	3rd Crop *[Code Box 1]*	Land Preparation Technology [*Manual = 1, Animal = 2, Animal & Manual = 3, Mechanized = 4, Other = Describe*]
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					

Table 3b: TABLE SHORT SEASON (SEPTEMBER 2005 TO January 2006)

ID	Parcel Size in Acres	Main Crop *[Code Box 1]*	2nd Crop *[Code Box 1]*	3rd Crop *[Code Box 1]*	Land Preparation Technology [*Manual = 1, Animal = 2, Mechanized = 3, Other = Describe*]
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					

Code box 1: Maize = 1, Bean = 2, Tea = 3, Sugar cane = 4, Irish Potatoes = 5, Sweet Potatoes = 6, Fodder crops = 7, Vegetables = 8, Cassava = 9, Other (specify)

Code box 2: Kg =1, Numbers = 2, 90 kg bags = 3, Gorogoro =4, Debe = 5, Other (specify)

*Assume you would plant one acre of…. on **your** farm*

THIS QUESTION DOES **NOT** APPLY TO THE ACTUAL YIELD OBTAINED IN THE CURRENT YEAR, BUT REFERS TO THE FARMER'S (**NOT HIS NEIGHBOUR'S**) PAST EXPERIENCE ON HIS OWN FARM

Table 4: Hypothetical Yields

Crop name	**Main** Crop Yield/Acre in a Normal Year	Yield Unit [*Code Box* 2]	**Main** Crop Yield/Acre in a Good Year	**Main** Crop Yield/Acre in a Bad Year
Maize (+ Beans) Long Season				
Beans (alone) Short Season				
Irish Potatoes				
Sweet Potatoes				
Tea (Mature bushes)				
Sugar Cane (First Crop)				

Code box 2:
Kg =1,
Numbers = 2,
90 kg bags = 3, Gorogoro =4,
Debe = 5,
Other (specify)

The following questions concern membership to different social organization or groups that you might be involved in:

Table 5: Membership in Social Groups

Name of your group(s)	Type [*Work group=1 Farmer group=2 Self-help/credit group=3 Merry-go-round=4 Women group=5 Family/clan group=6*]	Number of meetings per month	Leadership position that you might hold [Ordinary member=0,*Chairman=1, vice-chair=2, Secretary=3, vice-secretary=4, organising secretary=5,Treasurer=6, Vice-treasurer=7, Other = specify*]

The following questions concern the distance between your homestead farm to the nearest forest edge, nearest input and output markets:

Table 6: Shortest Distance to Forest Edge and Markets

	Name	Distance in km	Transport Type You Usually Use *[Walking = 1, Bike = 2, Car/Bus/Motorbike = 3, Company Transport Service = 4]*	Time spend in hours
Nearest Forest Edge				
Nearest market place for tools, seeds, and fertilizer				
Nearest market place to sell your produce				

The following questions concern the members of your household (those that <u>live</u> with you in the household).

Table 7: Household Demographic Characteristics for all Household Members

ID Code	Name	Relation to HH head [*HH head=1, Father/Mother=2 Daughter/Son=3, Other relative=4 Non-relative=5*]	Sex [M=1 F=2]	Age (Yrs)	Formal Education [Yrs]	Marital Status of HHH [*Married/living together=1 Married but not living together=2 Divorced/separated=3 Widow/widower=4 Single=5*]	Main Occupation *[Farming = 1 Salaried worker =2 Self-employed=3 Student=4 Retired/not able to work=5*]	Farm Work Per Year [*100% = 1 75% = 2 50% = 3 25% = 4 0% = 0*]
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

2.2 For how long have you been farming in this area?.....

2.3 How many of the children between 6 and 15 years attend school?.....

If not all of them, why not?

a) Lack of school fees

b) To work in the farm

c) They have refused schooling

d) Other

(Specify)……
……

2.4 How much money did your household receive as remittances in the last 12 months? Kshs……

2.5 How much money did you or any other member of the household receive as pension in the last 12 months? Kshs……

2.6 How much did your children receive as bursary in the last 12 months? Kshs……..

This questions concern off-farm activities that you and the members of your household might be involved in during the last 12 months.

HELP CALCULATION OF ANNUAL INCOME (E.G. BY CALCULATING MONTHLY AVERAGES)

Table 8: Off-farm Income Sources during the last 12 months

Type of off-farm activity	Household member ID COPY DOWN FROM TABLE 7	Total Annual Income in Kshs
HH member 1		
Farming activity (employed)		
Non-farming activity (employed)		
Non-farming activity (self-employed)*		
HH member 2		
Farming activity (employed)		
Non-farming activity (employed)		
Non-farming activity (self-employed)*		
HH member 3		
Farming activity (employed)		
Non-farming activity (employed)		
Non-farming activity (self-employed)*		
HH member 4		
Farming activity (employed)		
Non-farming activity (employed)		
Non-farming activity (self-employed)*		

* TO INCLUDE RENTAL INCOME OBTAINED FROM RENTAL HOUSES OR LAND

PART III: FOREST EXTRACTION: DIRECT BENEFITS & COSTS

THE ENUMERATOR SHOULD REMIND THE RESPONDENT THAT THE FOLLOWING INFORMATION WILL BE TREATED ABSOLUTE CONFIDENTIALITY

The following questions concern benefits that you obtain from the forest and the costs that you incur in the process.

3.1 Where do you obtain products such as timber, firewood, thatching grass and charcoal?

a) From the forest
b) From the market (buying)
c) Other (specify)…….

3.2 If not directly from the forest, where do you think they originally come from?

.....

.....

Did you directly obtain any products from the forest during the last one year? Yes [ ] No [ ]

IF YES, PLEASE FILL TABLE 9

Table 9: Forest Products Harvested during the last 12 months

Forest Product	No. of Harvest trips per month (*Where applicable)*	Time Spent (Hrs/trip)	HH member Involved HHH=1 Spouse=2 Children=3 Hired labour=4	Hired Labor cost Per trip	Qty harvested (quantity)	Units [*codes below*]	No. of months of harvesting per year	Cost of permit per month
Building Materials including Timber								
Medicinal Plants								
Edible fruits								
Mushrooms								
Thatching grass								
Fodder (Cut grass)								
Firewood								
Grazing								
Charcoal								

Codes: Kg =1, Numbers = 2, 90 kg bags = 3, Head lot = 4, Bundles=5 other (specify)

The following question relate to alternative sources of forest products

Table 10: Alternatives to Forest Products during the last 12 months

Forest Product	Alternative source [Own farm=1, Purchased=2, Other (Specify)]	Amount obtained	Unit [*codes above*]	Per [*year = 1 month = 2*]	Value in Kshs/Unit of the amount obtained
Building Materials including Timber					
Medicinal Plants					
Edible fruits					
Mushrooms					
Thatching grass					
Fodder (Cut grass)					
Firewood					
Grazing					
Charcoal					

The following questions concern crop destruction by wild animals from the forest

3.2 Did animals from the forest damage your crops during the last 12 months? Yes [ ] No [ ]

3.3 If yes, did you guard your farm against attacks by wild animals during the day? Yes [ ] No [ ]

3.4 If yes in 3.3, during which months of the year? .....

3.7 Did you guard your farm against attacks by wild animals during the night? Yes [ ] No [ ]

3.6 If yes, which months of the year? .....

IF YES TO 3.2, PLEASE FILL TABLE 11

Table 11: Crop damage by Wild animals during the last 12 months

Type of Animal	Types of crops damaged	Area planted/ number of trees	Code [*acres=1, number=2*]	Estimated total production without damage	Code box below	Total production after damage

Code box: Kg =1, Numbers = 2, 90 kg bags = 3, Gorogoro =4, Debe = 5, Other (specify)

3.5 Did animals from the forest attack your livestock (including dogs) during the last one year? Yes [ ] No [ ]

IF YES, PLEASE FILL TABLE 12

Table 12: Livestock Attack by Wild animals during the last 12 months

Type of wild animal	Livestock attacked	Number killed	No. of animals injured	Value of livestock killed (Kshs)	Value of livestock injury (Kshs)

The following questions concern installation of protective measures you employ to avoid or minimise crop damage and livestock by wild animals

Table 13: Installation of protective measures to avoid crop and livestock damages

Protective Measure	Materials/Equipments (State Units)	Labour (Man-Hours)	Cost of Materials & Equipments (Kshs)	Cost of Labour (Kshs)

The following questions concern maintenance of protective measures you employ to avoid or minimise crop damage and livestock by wild animals

Table 14: Maintenance of protective measures to avoid crop and livestock damages

Protective Measure	Materials/Equipments (State Units)	Labour (Man-Hours)	Cost of Materials & Equipments (Kshs)	Cost of Labour (Kshs)

Part IV

Community Participation & Transaction Costs:

SELLING

4.1 Did you sell any product from Kakamega forest in the last one year? Yes [ ] No [ ] IF NO GO TO (4.10)

4.2 If Yes, which one(s)……..

4.3 Explain how you first came to know there were customers for products from the forest and how you came to sell your products to them at an agreeable price? …….

.....

.....

.....

4.4 Did you spend any CASH MONEY for activity (4.2) above? If yes how much? Kshs……..

4.5 How much time did you spent on activity (4.2) above? Hrs……

4.6 Any other cost you incurred on the activity (4.2) Kshs……

4.7 What have you done or do you do when you want to get higher prices for forest product

……

……

……

……

4.8 Did you spend any CASH MONEY for activity (4.6) above? If yes how much? Kshs……..

4.9 How much time did you spent on activity (4.6) above? Hrs ……

4.10 Any other cost you incurred on the activity (4.6) Kshs……

BUYING

4.10 Did you buy any product(s) from Kakamega forest in the last one year? Yes [ ] No [ ] IF NO GO TO 4.19

4.11 If Yes, which one (s)……

4.12 Explain how you first came to know there were sellers of products from the forest and how you came to buy the products to them at an agreeable price

……

……

……

4.13 Did you spend any cash money for activity (4.12) above? If yes how much? …… Kshs

4.14 How much time did you spent on activity (4.12) above? ……hrs

4.15 Any other cost you incurred on the activity (4.12) ……Kshs

4.16 What have you done or do you do when you want to get market information or to strengthen your negotiations for lower prices of forest products?

.....

.....

.....

.....

4.17 Did you spend any cash money for activity (4.16) above? If yes how much? …… Kshs

4.18 How much time did you spent on activity (4.16) above? ……hrs

4.19 Any other cost you incurred on the activity (4.16) ……Kshs

The following section concerns your participation in forest conservation activities in the last one year

4.19 Did you participate in any forest conservation activity in the last one year? Yes [ ] No [ ]

IF YES, PLEASE FILL TABLE 15

Table 15: Participation in Forest Conservation Activities

Activity Involved in	Form of contribution (Time=1, Cash=2,Other (specify)	Quantity	Units [*hours=1 Kshs=2*]

4.20 Suppose that there is an agricultural company that intends to begin a major farming operation in your area. They are looking for manual workers who are willing to receive the lowest daily wage. In your current situation, if they offer you Kshs 50 per day (without food) would you do it? Yes [ ] No [ ] IF NO: suppose he offers you ……INCREASE BY 10 Kshs UNTIL THE FARMER AGREES AND NOTE DOWN THE VALUE AT WHICH HE CHANGED HIS MIND.

Part V: Perception towards and Satisfaction with Forest Management System

5.1 Which organization is associated with management of forest in your area?

Forest Department (FD) [ ] Kenya Wildlife Service (KWS) [ ] Both FD & KWS [ ] Friends Church [ ]

5.2 Is the conservation of the forest important to you? Yes [ ] No [ ]

5.3 If yes in 5.2, what are the specific aspects of forest conservation that are important to you?

……

……

……

……

……

……

5.4 5.4 If no in 5.2 above, what are your reasons?

……

……

……

The following question relate to your satisfaction level with Specific Aspects of Management

5.5 What is your overall satisfaction with the way the forest in your area is managed?

USE WATER DRUM PICTURES

1 [Very good] 2 [Good] 3 [Fair] 4 [Poor] 5 [V. Poor]

5.6 What are the reason(s) for your ranking in (a) above?

a) Allows local people to extract from the forest
b) Respond when informed of illegal activities
c) Involve local people in decision making
d) Strictly managed the forest (does not allow forest destruction)

Other

(Specify)……

…..

From your perspective as a local dweller, please rank the management system in which you operate according to the following aspects of forest management:

Table 16: Ranking specific Aspects of Management

Management Aspects	Ranking USE WATER DRUM PICTURES 1 [V. Good] 2 [Good] 3 [Neutral] 4 [Poor] 5 [V. Poor]
Involving local people in decision-making process	
Making of extraction rules, e.g. determination of access fee and permits	
Making of enforcement rules	
Preservation of certain unique areas of the forest (e.g. Buyangu)	
Resolution of conflicts	
Having mechanisms for conflict resolution, e.g. meetings	
Resolution of Wildlife-human conflict	
Promotion of environmental conservation programs	
School outreach programs	
Environment improving activities, e.g. tree-planting days	
Provide people with alternatives to forest extraction	
Promotion of energy-saving technologies, e.g. improved 'jikos'	
Provision of tree seedlings	
Promotion of alternative sources of income e.g. curio shops	
Clarity of rules	
Straightforwardness of the rules [*Are all rules of forest extraction clear to you?*]	
Enforcement of rules [*is there punishment if one disobeys the rules?*]	
Satisfaction with level of forest extraction allowed	
Provision of Conservation Incentives	
Provision of employment to the local people	
Prevention of damage of crops & livestock	
Compensation given for crop or livestock damage	

The following questions relate to the products that you produce and consume for the last 12 months.

CONVERT TO THE COMMON METRIC UNITS WHENEVER POSSIBLE

Table 17: Agricultural production and consumption expenditure during the last 12 months

	Product	Quantity produced	Unit [*code*]	Quantity sold (SAME UNIT)	Quantity bought (SAME UNIT)
1.	Maize (grains)				
2.	Beans (pulses)				
3.	Sweet Potatoes				
4.	Vegetables				
5.	Fruits				
6.	Milk				
7.	Rice				
8.	Maize flour				
9.	Sugar				
10.	Cooking Oil				
11.	Meat (beef)				
12.	Chicken				
13.	Kerosene (fuel)				

Code
Kg =1
Numbers = 2
90 kg bags = 3
Liters = 4
Five-Shillings
Polythene bag=5
Other (specify)

QUESTIONS 5.6 – 5.8 ARE TO BE ANSWERED BY THE ENUMERATOR THROUGH OBSERVATION.

5.7 Size of residence building: …….(area) ……..(unit)

5.8 Building material:…….. [*Wood = 1, Bricks (clay) = 2, Stones = 3, Mud = 4, Other = describe]*

5.9 Roof:…… [*Tiles = 1, Iron sheets = 2, Thatching grass = 3, Other = describe]*

5.10 Could you assign the value of all your pieces of land today? …….(Kshs)

5.11 How much does your family usually spend on clothing **per year**…….(Kshs)

5.12 How much does your family usually spend on food stuff **per month**…….(Kshs)

5.13 How much does your family usually spend for health **per year**……..(Kshs)

5.14 How much does your family usually spend for transport **per month** ……..(Kshs)

5.15 How much money did your family spend for schooling (Fees, books, Uniforms) in the last 12 months? Kshs……

The following questions relate to items that you have in your household or use for farming

Tables 18: Household and Agricultural Assets and Access to Services

	Does you household own or have access to the following items	*Yes = 1 / No = 0*
1.	Electricity	
2.	Piped water	
3.	Radio	
4.	Bike	
5.	Car	
6.	Motorbike	
7.	Ox cart	
8.	Gas stove	
9.	Charcoal stove (jiko)	
10.	Fridge	
11.	T.V. set	
12.	Solar panel	
13.	Phone	
14.	Water storage tank	
15.	Plough	
16.	Wheelbarrow	
17.	Sprayer (pesticides)	

The following questions relate to animals that you own.

Table 19: Animal Ownership

	Does your household own the following animals	How many?
1.	Cow	
2.	Ox	
3.	Donkey	
4.	Pig	
5.	Chicken	
6.	Sheep/Goats	